# POWER PLANT ENGINEERING

Established Over 31 Years

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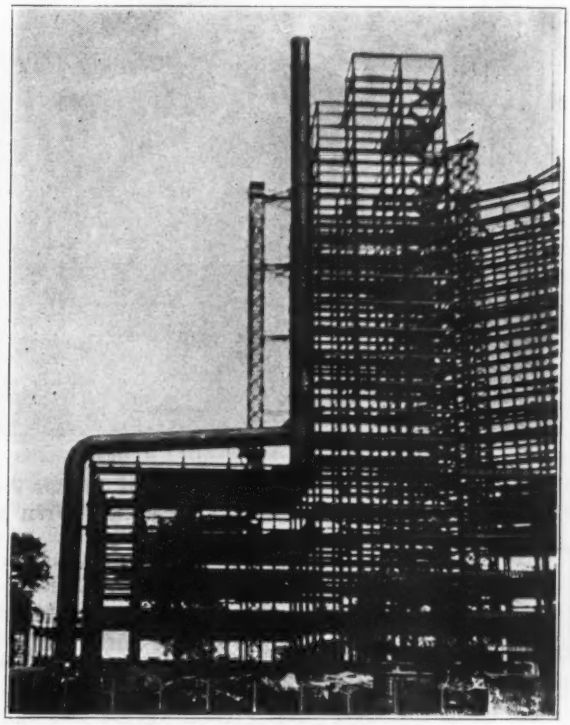
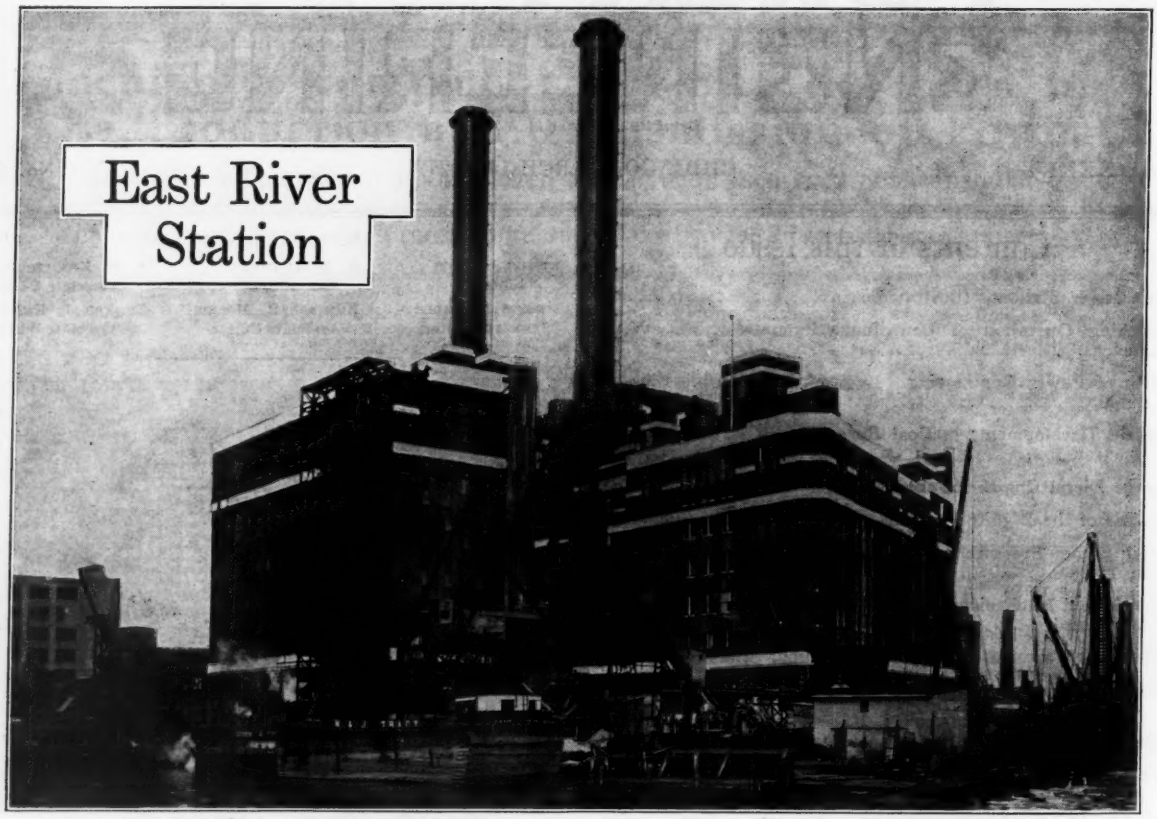


## Athletic Smoke

FROM THE DAWN of history smoke has "curled lazily upward" from the pages of innumerable novels but at last a fearless adventurer has broken the shackles of convention. Smoke from the boilers of a new athletic club building near Chicago's famous Oak St. beach will gyrate up the trick stack shown above to the merry tune of the Highland Fling from the gymnasium.

Pitifully few, however, are the occasions on which the architect or engineer can so indulge his fancy. Gone are the days when smokestacks were bought by sections like stovepipes and the height determined by the imagination of the salesman. Gone are the days when one built his chimney from rocks dug out of the front yard to the dimensions deemed necessary by younger members of the family to admit the generous girth of Santa Claus.

This matter of design is now given important consideration and in our next issue, J. G. Mingle, one of the few engineers qualified to cover this important but little known subject, will give design data and discuss some of the important considerations.




EAST RIVER STATION, THE LATEST ADDITION TO THE NEW YORK EDISON SYSTEM, COMMENCES OPERATION WITH AN INITIAL INSTALLATION OF 120,000 KW.

AMONG THE MANY new large generating stations which have been under construction in various parts of the country during recent years, none has attracted greater interest than the East River Station of the New York Edison Co. This station, the latest addition to a system of which the Pearl Street Station was the first unit, will have a generating capacity of over one thousand times that of the historic Pearl street plant in 1882.

The progress of the electric light and power industry has been rapid. Pearl Street Station, which started operation on September 4, 1882, was soon supplemented by the 26th and 39th Street stations in 1888, the 53rd Street Station in 1892 and the 12th Street Station in 1894, all long since discontinued as generating plants and now used as converter substations. In 1891 the Duane Street Station was placed in operation and in 1901, Waterside No. 1. Waterside No. 2, opened in 1906, was followed by the United Company's stations, Sherman Creek in 1913 and Hell Gate in 1921, and now comes the latest addition to the system, the East River Station, placed in operation November 23, 1926.

From a few hundred kilowatts in 1882, the maximum load carried by the Edison-United system has grown to 732,000 in 1926. The annual output from the generating stations in the same period has increased from a negligible quantity during the first years of operation to over 2½ billion kilowatt-hours last year, representing an average yearly increase of roughly 12 per cent. Such a rate of increase compels continual additions to the system with the necessity of building with an eye to the future, since huge modern power stations can no longer be built in a matter of months.

In 1924 it was seen that a new station must be projected at once, primarily to supplement the 25-cycle system, with provision also for the possible addition of 60-cycle generation in the meantime with a frequency changer of large capacity to provide for transformation from 25 to 60 cycles and vice versa, serving also for receiving or delivering energy to tie connections with the Brooklyn Edison system. The continued growth of the demand on the 25-cycle system with its center of load located in the southern half of the Island indicated the selection of a new plant within economic range of the maximum 25-cycle generator voltage, 11,400 v., and the site on the East River at the foot of 13th-15th streets, adjoining the site occupied by the Consolidated Gas Company, was found to present notable advantages. The factors which determined the selection of this site were first: an adequate continuous area for immediate requirements and future expansion, both as to building construction and high tension feeder outlets, and second, favorable water front conditions, providing adequate water depth for docking coal-carrying, ocean-going steamers of 10,000 tons capacity.

When completed, the plant proper will occupy the block between 14th and 15th street from Avenue C to the East River, an area approximately 1100 ft. long by 200 ft. wide, The mill house, outdoor coal-handling and storage facilities occupy the property from the

south side of 14th street to the north side of East 13th street and extending from the East River to Avenue D.

The long narrow shape of the plot on which the main building is erected has established space limitations that required careful planning to accommodate equipment of the desired capacities. The boiler room, 102½ ft. wide will be approximately 917 ft. long when completed. The turbine room will be 808 ft. long, 58 ft. wide and is located between the boiler house and the electrical galleries. A plan view of the present installation is shown in Fig. 2.

The station, which was designed by Thomas E. Murray, Inc., in association with the engineers of the New York Edison Co., at present has a generating capacity of 120,000 kw. in two 60,000-kw. units. Succeeding units will probably be of larger size, since single shaft units of 120,000-kw. capacity can now be built. The ultimate capacity will be probably in the neighborhood of one million kilowatts.

While East River Station embodies most of the latest developments of the power plant field, the most interesting features are to be found in the steam-producing equipment, which differs notably from anything used in power plants heretofore constructed. This equipment makes use of a completely water-cooled boiler furnace of improved design, completely eliminating the use of fire brick refractories. The boilers have a normal rating of 50,000 lb. of steam per hour, but with the type of combustion equipment installed they can be operated at continuous overloads so as to produce 250,000 lb. of steam per hour, something like 500 per cent of rating. The furnaces are fired with pulverized coal.

The heat balance system is of the regenerative type, bleeding the turbines at three points. Steam pressure of 375 lb. is carried, superheated to a total temperature of 700 deg. F. In the operation of the auxiliaries, steam drives are used for the essential units on which the continuity of service absolutely depends, while the others are electrically operated. This is in accordance with the New York Edison Company's usual practice, but in the case of East River, it was not adopted until an exhaustive analysis of the economics of steam versus electrically driven auxiliaries had been made. Some of the electrically driven auxiliaries obtain their current from the d.c. house system, consisting of four 500-kw., steam driven, d.c. turbo-generators and two storage batteries, but the coal preparation motors and remaining auxiliaries are driven by a.c. motors, taking their power through transformers directly from the main bus.

FIG. 1. A VIEW ON THE FIRING FLOOR SHOWING PULVERIZED COAL FEEDER LINES TO ONE BOILER

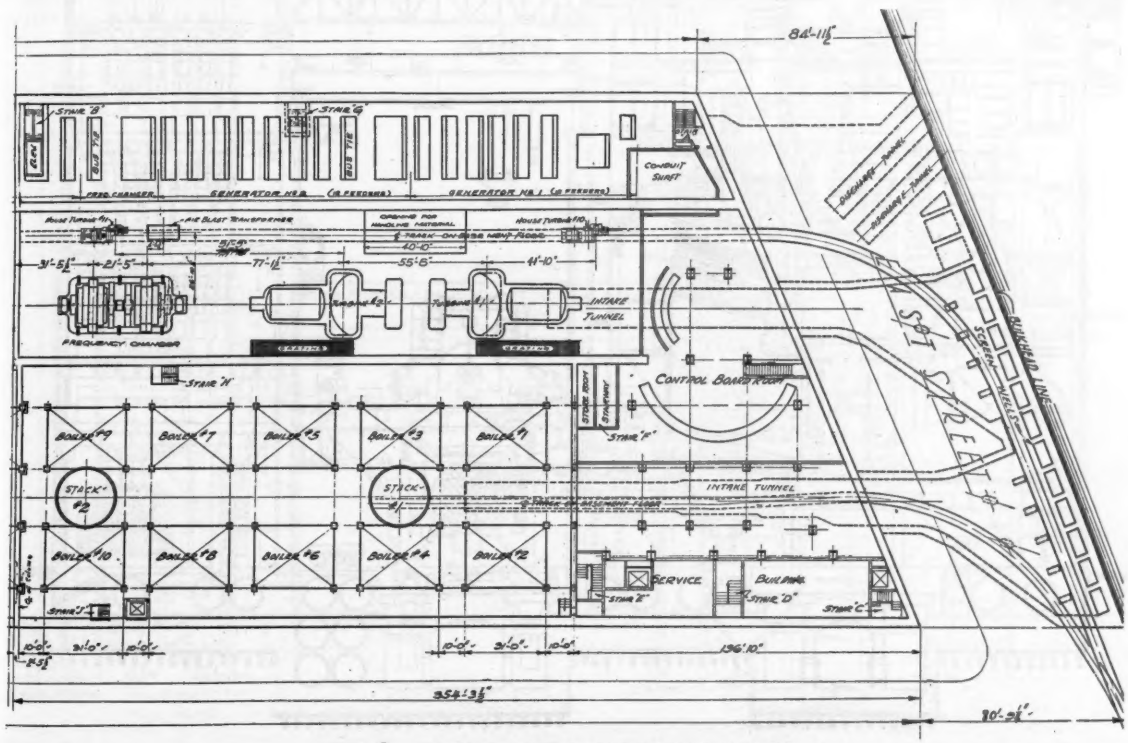



FIG. 2. PLAN OF THE PRESENT INSTALLATION

It is expected that this station will deliver a kilowatt hour on the station bus for about one pound of coal.

### Coal Handling

Coal is delivered to the station direct to the bulkhead by 10,000-t., ocean-going colliers. These are unloaded by two electrically operated coal towers, each of which will be capable of handling 350 t. of coal per hr. and will have a traveling range of 307 ft. along the bulkhead. They are provided with 3-t. buckets, have a hoisting speed of 930 ft. per minute and 65-ft. lift, the main hoist being driven by 250-hp., 2300-v., 25-cycle, 150-r.p.m. motors. A ring crusher on each tower driven by 75-hp. motors breaks the coal to 1¼-in. and smaller sizes.

From the crusher the coal may be fed either onto this conveyor, which dumps the coal on the landward side of the tower, to be taken to the 48,000-t. storage yard by drag scrapers, or it may be fed to either one of the two 36-in., 320-ft. belt conveyors located on the bulkhead under the towers. The latter two conveyors deliver the coal to two other conveyors equipped with automatic scales which run back about 165 ft. from the bulkhead at right angles to the first pair and deliver coal to a single 54-in., 35-ft. belt of 750 t. capacity, which in turn feeds the skip hoists located near the end of the mill house, and which feed the coal into the raw coal bunkers on top of the mill house.

In the mill house besides the raw coal bunkers are located the steam driers for drying the coal and the screen mill pulverizers. The pulverized coal from the mills is forced by air pressure through transporting pipes across the connecting bridge into the individual bins of the boiler house located above each boiler from which it is picked by the feeders and with the com-

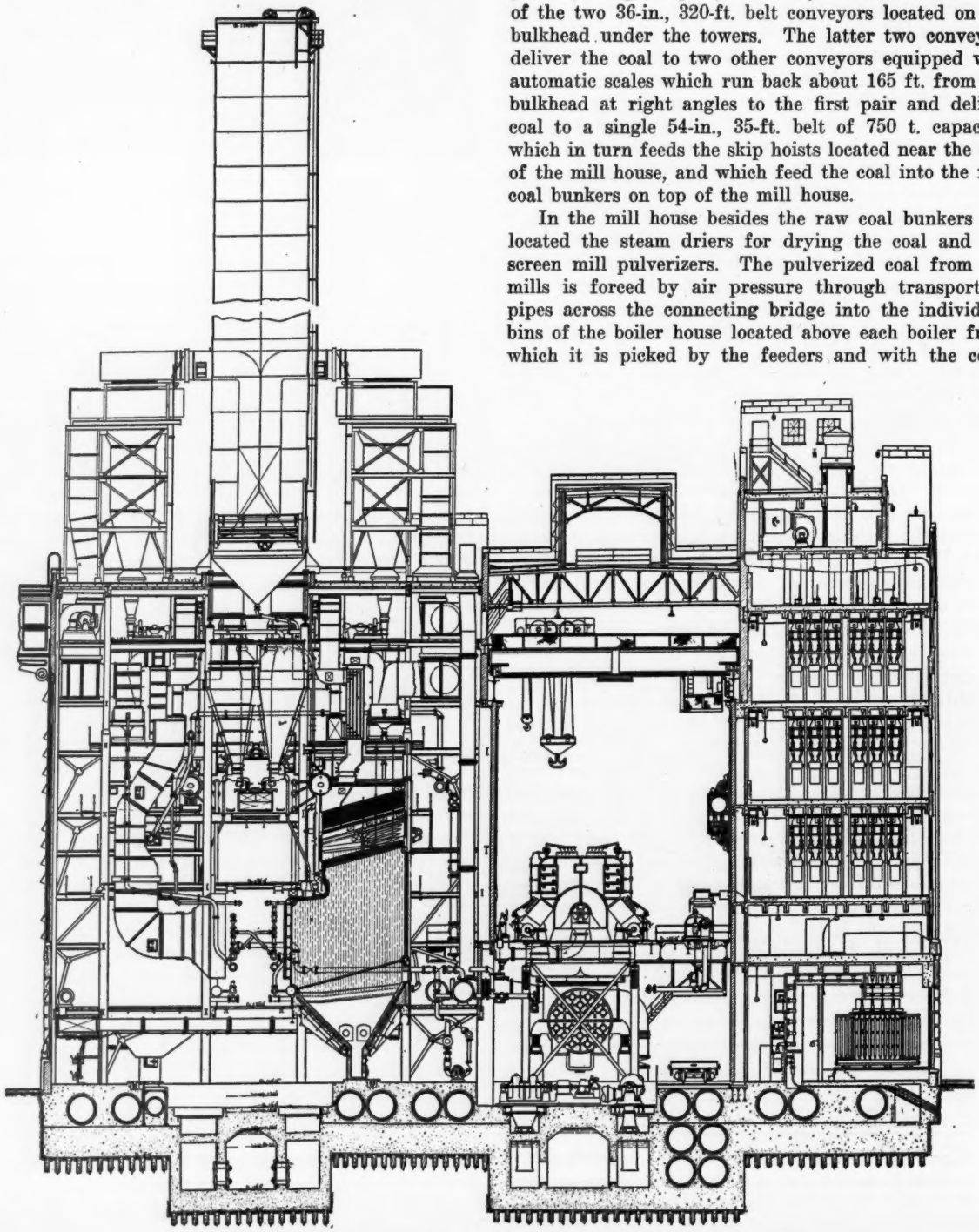


FIG. 3. SECTIONAL VIEW THROUGH THE BOILER ROOM, TURBINE ROOM AND SWITCHHOUSE

pressed air from the primary air duct is forced into the furnace through the burners. This is shown by diagram in Fig. 4.

The raw coal bunkers have a combined capacity of 5000 t. divided into three sections. Duplex horizontal gates at the bottom of the bunkers control the coal flow to vertical coal driers immediately below.

There are two driers per mill. They are rectangular in sections and contain cast iron steam grids through which the coal passes down to the mill feeders. The moisture laden air from the driers is drawn into a horizontal flue from which it is exhausted by three motor driven fans of 28,000-c.f.m. capacity and discharged into six cyclone dust collectors. Dust caught in the collectors is discharged into the transport pumps. When desirable driers may be emptied through a discharge pipe into a 1½-cu. yd. hand car which runs on rails on the ground floor of the mill house.

The mills, or pulverizers, are set upon steel and concrete foundations located on the ground floor of the mill house immediately below the driers. Each is provided with two motor driven feeders which regulate the flow of coal from the driers to the mill. Between the feeders and mill are located magnetic separators to eliminate scrap iron from the coal before it reaches the mill. There are six 70-in. screen mills in the present installation, each having a capacity of 15 t. per hour and driven by a 250-hp., 375-r.p.m., a.c. motor. The pulverized coal from the mill passes directly to the transporters, of which there is one per mill.

The transporters are vented through the exhauster flue to the dust collectors. They have a capacity of 25 t. per hour and are connected into a transport pipe system, which carries the coal in two 10-in. headers across the bridge over 14th St. to the boiler house. In the boiler house the coal may be either sent directly to the 100-t. individual boiler bins, or may be first diverted to the two 10-t. weigh bins and retransported by means of 25 t. per hr. transporters to the boiler bins. This latter system permits the weighing of the coal fed to each boiler. From the boiler bins the coal is fed by direct current motor driven feeders to the burners, of which there are ten per boiler.

An automatic bin indicating system will be installed to indicate the level of the powdered coal in each of the individual boiler bins. It consists of floats that are continuously raised and lowered in the bins by means of cams driven from either one of two revolving shafts that extend the entire length of the boiler room. Upon lowering, the float comes in contact with the top of the powdered coal and its position is indicated on a calibrated scale located in front of the boiler at the operating level.

In addition to the raw coal bins and mills, and other equipment described above, the mill house contains four air compressors each of 1391-c.f.m., 100 lb. per sq. in. capacity, driven by 300-hp., 214-r.p.m., 2300-v. synchronous motors, which furnish compressed air for the transporters, and a steam driven 1000-kw. house alternator, 3-phase, 25-cycle, 2300-v., 3780 r.p.m. This machine is connected to the high pressure steam line from the boiler house and exhausts into a main which supplies the coal driers. The power generated is used to take a portion of the load of the mill house motors, the amount of power generated being dependent upon the steam required by the driers.

### Steam Generating Equipment

At the present time there are installed six boiler units. The ultimate length available for boiler room is 910 ft., which is sufficient for 44 boilers, if that number will be required for the ultimate million kilowatts of generating capacity planned.

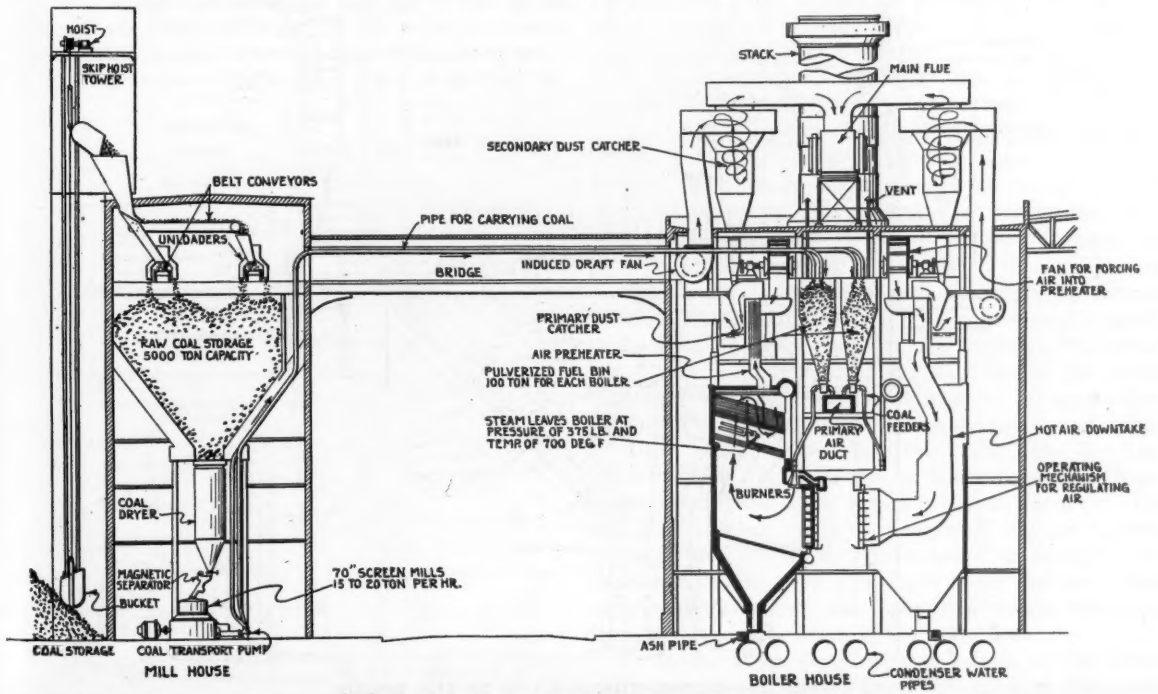



FIG. 4. COAL PULVERIZED IN THE MILL IS TRANSPORTED OVER A BRIDGE ACROSS 14TH ST. TO THE BOILER HOUSE

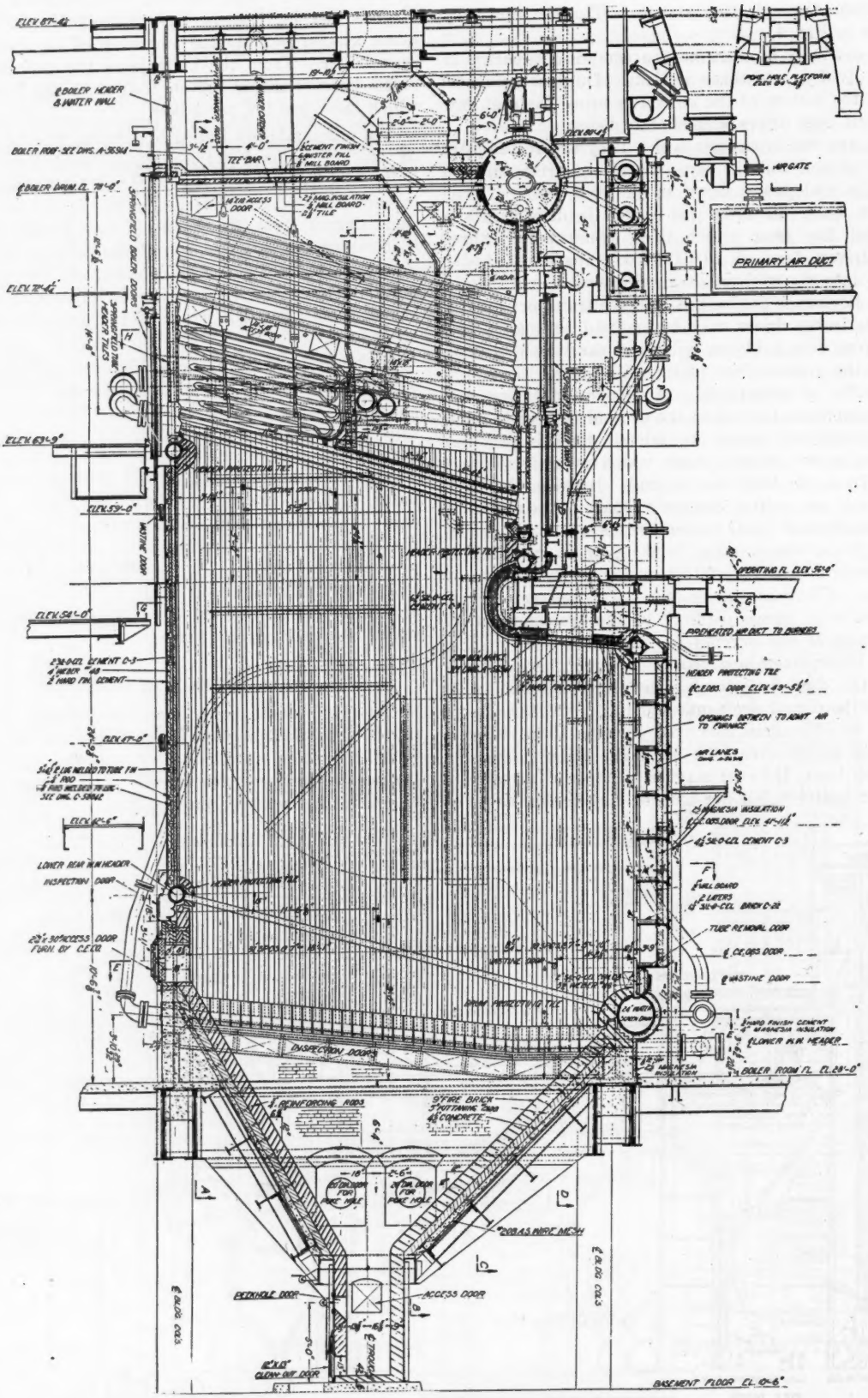



FIG. 5. SECTION THROUGH ONE OF THE BOILERS

Each of the six units installed have 14,809 sq. ft. of heating surface, exclusive of water walls or superheaters, and consists of 27 sections with 32 tubes per section, arranged two wide by 16 high. One 54-in. drum is provided for each boiler. The top horizontal circulating tubes are 3 in. in diameter and 108 in number.

The furnace construction is unusual, as may be seen from Fig. 5.

The furnace is entirely surrounded on all sides by water-cooled surfaces in order to eliminate all refractory walls. The walls are constructed from plans of Mr. Thomas E. Murray, Senior Vice-President of The New York Edison Company.

All side wall tubes are 4 in. in diameter and No. 6 B.W.G. The side walls are constructed of vertical tubes with a maximum length of 32 ft. 10⅝ in., terminating at each end in 11¾-in. headers. These headers are made from forgings and are 1½ in. thick. The front wall is made up of vertical tubes with 11¾-in. headers at the top and a 24-in. I.D. forged drum at the bottom. The rear wall is built up of vertical tubes terminating in 11-in. headers top and bottom.

The 24-in. drum at the bottom of the front wall is provided with manhole covers at each end, the other headers being too small to allow for these manholes. All tubes comprising these walls are provided with fins similar to the construction originally installed at the Hell Gate Station of The United Electric Light & Power Co., the only change being that the fins do not overlap, a small clearance being provided between the ends of the fins. It was impossible to overlap the fins in these boilers on account of inability to replace the tubes due to interferences.

As the vertical system of firing was adopted for this station, it is necessary to have a flat arch at the front of the boilers. Brickwork was also eliminated at this point by the installation of a water-cooled arch built up of 4-in. tubes terminating at one end in the upper header of the front wall, and at the other end in a header located directly below the mud drum of the main boiler. These tubes are also provided with fins similar

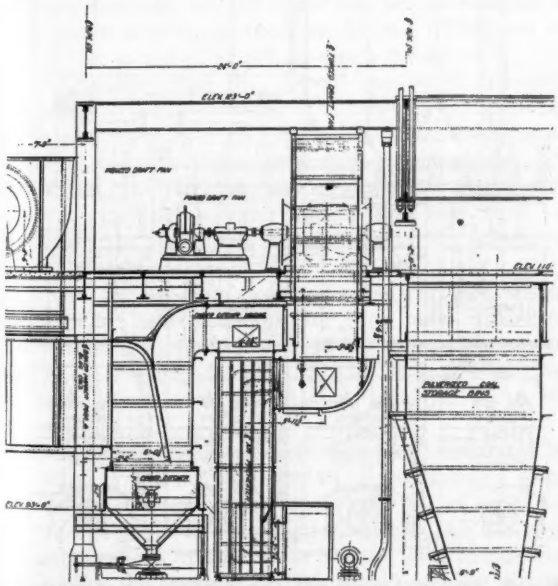


FIG. 6. EQUIPMENT ABOVE THE BOILER SHOWN IN FIG. 5

FIG. 7. CONSTRUCTING ONE OF THE 1550-HP. BOILERS AT EAST RIVER

to those on the walls of the boiler. The only refractory material on the interior of the furnace is around the various drums for the walls. Tile is used for this protection.

The water screen is of the standard design. The screen tubes are connected in with the drum and headers for the side walls. The tubes are placed 14-in. center to center.

The circulation is as follows:

An auxiliary header is provided below each end of the main drum of the boiler. There are seven 4-in. tubes connecting the main drum with each of these headers, which are made from forgings. Water flows from these headers through 6-in. pipes to the opposite ends of the bottom headers and then vertically through the side wall tubes to the upper headers, from which it passes at one end through a 10-in. pipe on each side to a header parallel to the main drum and 4½ inches above the center line of the main drum. The flow is from this header into the main drum through fifteen 4-in. tubes.

The short tubes at the front of the side walls discharge into a short header and from thence to a header parallel to the main drum into which the mixture of steam and water finally flows. The header last mentioned also serves as a return for water and steam for the front wall.

Circulation to the front and back walls is through 15 tubes, leading from the main drum to a header parallel to the main drum and 5 ft. 7½ in. below the center line of the main drum. From this header the water flows downward through two 8-in. pipes to two headers parallel to the 24-in. drum previously mentioned. This auxiliary header is tied into the 24-in. drum by 4-in. tubes at five points. Water is taken from this 24-in. drum through the water screen tubes and then into the header at the bottom of the rear wall, whence it flows vertically into the upper header and then through nipples into the bottom of the upper boiler sections. The water and steam from the walls then pass to the main drum with the circulation of the main boiler.

From the 24-in. drum at the bottom of the front wall water passes into the front wall tubes to the upper header of this wall, then through the tubes of the flat

FIG. 8. INSIDE OF ONE OF THE FURNACES SHOWING THE WATER TUBE WALLS

arch into the header directly below the mud drum. From this point the steam and water flow through two 8-in. pipes to an auxiliary header (previously mentioned) parallel to the main drum and 1 ft. 11½ in. below the center line of the drum. This auxiliary header is connected to the main drum by fourteen 4-in. tubes.

The weight of the rear wall of the furnace is carried directly from the upper boiler header sections. The front wall is suspended from steel work, as are the two side walls. All walls will expand down when heated. The upper header of the flat arch construction is carried on steel work and as this point is fixed while the main boiler expands downward, it is necessary to provide a seal at this point. The steel plate enclosure is made up by welding a thin plate to both the mud drum and the upper header of the flat arch. This is arranged in such a way as to take care of the expansion. Directly in front of these headers a tile partition is installed to prevent the radiant heat of the furnace from striking the headers. The same method of sealing has been adopted at the base of all walls. The bottom of the furnace is constructed of 4½-in. reinforced concrete slabs with 5 in. of diatomaceous material and 9 in. of fire brick.

The superheater is located between the upper and lower banks of boiler tubes, and has 3430 sq. ft. of heating surface arranged in 74 elements, each having five loops.

Above each boiler is located an air heater, which will raise the temperature of the air at normal rating approximately 390 deg. F. Gases will flow vertically through the air heater and then be discharged through a primary cinder and dust collector to a centrifugal collector, located above the roof, with the induced draft fans located between the two dust collectors. The combined effect of the two types of dust catchers installed in series results in a thorough cleansing of the furnace gases before they reach the stack, the solid particles being caught in the water bath of the primary dust catchers or precipitated by the centrifugal action of the cyclone. The induced draft fans are driven by steam turbines with a maximum of 400 hp. A 7 to 1 reduction gear is used between the turbine and the fan. The capacity of the fan is 150,000 c.f.m. at 8/5 in. water gage.

The forced draft fans are located on the level just below the roof and have a capacity of 75,000 cu. ft. of air per minute at 6.4 in. static pressure. Each fan is driven by a steam turbine of 115 hp. through a 4 to 1 reduction gear.

All boilers are equipped with soot blowers, 20 units per boiler, 4-in. safety valves, feed water regulators, and deconcentrators. They are all automatically controlled so as to maintain the coal, air and water supplied to them in proper proportions at all times to meet load conditions. A supermaster control panel is provided by means of which the control of all boilers in the plant is centralized at one point. The controllers and piping associated with this supermaster panel are in duplicate to insure against failure of the system. Each boiler is also provided with a control panel so that it may be controlled separately if desired.

Control is effected by the steam pressure in the line, which regulates the air pressure to the individual boiler controllers. These in turn regulate the air pressure to the various regulators which control the forced and induced draft fans, coal feeder motors, primary and secondary air dampers and the excess feed water pressure valves. The supermaster controller also controls the pressure to the regulators governing the boiler feed pumps and the primary air fans. A motor driven combination set consisting of an air pump, oil pump, air receiver and return oil tank is provided for supplying air and oil pressure to the operating system.

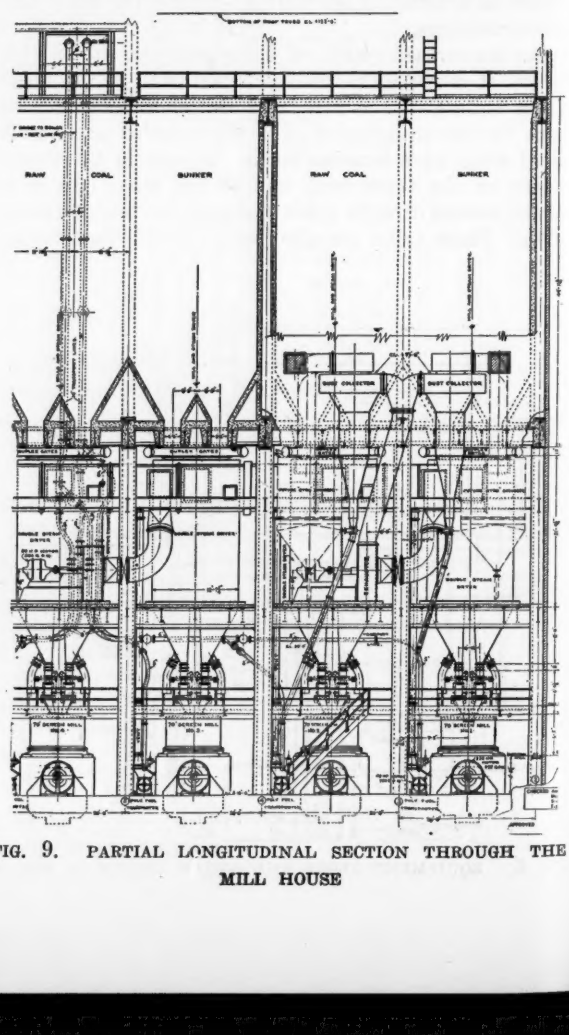



FIG. 9. PARTIAL LONGITUDINAL SECTION THROUGH THE MILL HOUSE

### Two 60,000-Kw. Turbo-Generators in Present Installation

The present installation of prime movers consists of two 60,000-kw. turbo-generators. These are 1500 r.p.m. units, using 375 lb. steam at 700 deg. F. and generating 25-cycle, 3-phase current at 11,400 v. They have 118-kw. direct connected exciters, supplying direct current at 250 v. The generators each have two external motor driven blowers for supplying the 110,000 cu. ft. of air per minute required for ventilating the windings. The air is circulated within a closed system that contains an air cooler consisting of nests of spiral finned tubes. The turbines have 20 stages and are of the single flow type with steam extraction points located at the 11th, 14th and 18th stages.

For supplying direct current for station lighting and for operating the boiler coal feeder motors and valve control motors, two 500-kw., 250/125-v., d.c. geared steam turbo-generators are installed. These receive steam at 375 lb. pressure and exhaust within the range of 10 in. of vacuum and 1 lb. gage back pressure. The speed of the units is reduced through a double helical reduction gear to 900 r.p.m. at the generator end.

In addition to the turbo-generators there is included in the present installation a 40,000-kw. frequency changer for converting 60-cycle, 13,800-v. current to 25-cycle, 11,400-v., or vice versa, and serves to tie in the New York Edison 25-cycle system with the United Electric Light and Power Co., and the Brooklyn Edison 60-cycle systems.

### Condensers Have 45,000 Sq. Ft. of Cooling Surface

Each of the main turbines exhausts into a 45,000-sq. ft. single pass surface condenser, having 8540 7/8-in. O. D. 18 B. W. G. seamless drawn admiralty mixture tubes, 23 ft. long between the plates. The tubes are packed with corset lace and fibre rings. The hotwell is rectangular in shape and has a capacity of 1500 gal. For removing air and non-condensable vapors from the condenser there are provided two 2-stage twin element steam jet air pumps with surface inter and after condensers, arranged so that either one or two elements of each pump may be operated as desired. They are designed for operation at 250 lb. steam pressure.

Condensate from the hotwell pumps of the main condenser is pumped through the tubes of the inter and after condensers operating in parallel, thus absorbing all the available heat of the steam used by the pump. The steam from the inter-condenser is returned to the main condenser through a water leg and that from the after condenser through a condensate trap to the hotwell of the main condenser.

There are two 8-in. non-condensing turbines driving two-impeller hotwell pumps for each main condenser. Each of these pumps has a 12-in. suction connection and is designed to deliver 1350 gal. of condensate per minute against a total dynamic head, including the vacuum of 135 ft.

Circulating water for each condenser is supplied by two 42-in. double suction bi-rotor pumps having a 48-in. suction and a normal capacity of 45,000 gal. of water per minute against a total dynamic head of 14.5 ft. One thousand gallons of this water will be used in the condensers for the turbines driving the circulating pumps. The normal speed of the pumps is 270 r.p.m.

When only one of the pumps is operating on the system it will discharge 57,500 gal. of water per minute against a total dynamic head of 7 ft. A cast iron exhaust piece rigidly connects the turbine casing with the condenser and to take up the expansion and contraction of the unit, supporting springs are provided.

The condenser is designed to produce a vacuum of 28½ in. when condensing 455,000 lb. of steam with 75,000 g.p.m. circulating water at 70 deg. F. The condensate temperature will be within 1 deg. of the temperature of the exhaust steam and the oxygen content of the condenser will not be in excess of 0.05 c.c. per litre.

The circulating pump turbine condensers are two pass containing 700 sq. ft. of cooling surface each equipped with two 2-stage steam jet air pumps.

One of the most difficult problems in the construction of the station was the construction of the huge

FIG. 10. THE TURBINE ROOM CONTAINS ONLY THE TURBO-GENERATORS AND THE FREQUENCY CHANGERS

condensing water tunnels. There are in all 9 intake and 9 discharge tunnels of cast iron pipe, each 6 ft. in diameter. The discharge tunnel outflows are located at the northern extremity of the plat, leaving a part some 150 ft. long to accommodate the intakes. The water screens operate under a very low water velocity.

### Heat Balance

Condensate from the main condensers passes through the air ejector condenser and after cooler, and then successively through four closed heaters. The first is supplied with steam extracted from the 18th stage of the turbine; the second is supplied with steam from the auxiliary exhaust header; the third is supplied with steam from the 14th stage of the main turbine, and the fourth from the 11th stage of the main turbine. At high loads the amount of steam from the auxiliaries may be more than the exhaust heater can condense. The excess steam is carried to the 18th stage bleed line through a loaded valve and thence to the 18th stage heater resulting in a decrease in the amount of steam bled from the 18th stage. The pressure in the auxiliary exhaust heater varies with the load from about 10 in. vacuum at low to 2 lb. gage at the high loads. The feed water heating system is self-regulating and requires no manip-

ulation whatever. The amount of steam bled from the various stages depends on the quantity of feed water passing through the heaters, inasmuch as each heater acts as a condenser for its steam. Makeup water is introduced into the main condensers for the purpose of deaeration. It is estimated that it will amount to approximately 2 per cent of the steam produced.

The table below shows the amount of steam absorbed in the heaters, the pressures and temperatures occurring at full load, 60,000 kw., for certain assumed auxiliary load conditions. It serves to illustrate the progressive heating of the feed water as it passes through the system.

| Heater | Lb. of Steam to Heaters | Steam Press., Lb. Per Sq. In. Abs. | Sat. Steam Temp. | Water Temp. |
|---|---|---|---|---|
| Ejector Cond. | 1200 | .6 | 85 | 80 |
| 18th Stage | 29,540 | 5.0 | 163 | 158 |
| Aux. Ex. | 39,000 | 13.1 | 206 | 201 |
| 14th Stage | 47,200 | 46.6 | 277 | 270 |
| 11th Stage | 51,250 | 127.5 | 346 | 339 |

The hotwell pumps provide the necessary head for pumping the water from the hotwells through the ejector condenser and the first stage heater into the second stage heater; from the second stage heater it enters the boiler feed pumps, which pump it through the 3rd and 4th stage heaters into the boilers. There are no economizers on the boilers. They are, however, provided with plate type air heaters, which raise the temperature of the air at normal rating, approximately 390 deg., the escaping flue gases leaving at approximately 325 deg.

### Piping

All high pressure steam piping is designed in accordance with the 400 lb. standard A. S. M. E. and supplied with Vanstone joints and motor operated cast steel valves. The boiler feed lines are designed in accordance with the 600-lb. A. S. M. E. standard. Motor operated valves are used for the 42-in. cast-iron circulating pump discharge lines and the 72-in. cast-iron condenser outlet lines. All valves 8 in. and larger in the auxiliary steam and boiler feed lines are provided with pads for the future installation of motors if found to be desirable at a later date.

Note: The electrical features of this station are described on page 356 of this issue.

# Checking Operation of Centrifugal Pumps

Methods of Using Pitot Tubes in Proportioning Load Carried by Pumps in a Battery. By C. W. Stevens

CENTRIFUGAL pumps are often elusive. When several are used in conjunction, pumping into the same standpipe or main, the quantity of discharge of each is not very obvious. Plunger pumps indicate their capacities at once, by their speed, stroke, leakage and general action, but centrifugal pumps can rotate at full speed without putting out a drop of water. They may simply churn the water as if a solid wheel.

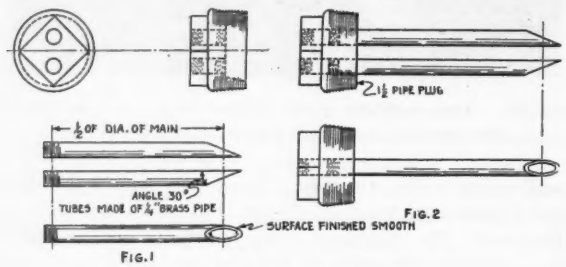



FIG. 1. DETAILS OF PITOT TUBE
FIG. 2. COMPLETED PITOT TUBE

It is a common occurrence in systems supplied by several pumps, that the capacities of the pumps in operation are greatly in excess of the actual known discharge, as shown by a meter or operating conditions. We ask ourselves what is wrong with which pump.

There is an exceedingly simple method of checking centrifugal pumps by means of a useful and inexpensive device, the Pitot tube. There is nothing mysterious about a Pitot tube, its construction, installation, or calculation. They can be made by anyone and be just as good as those purchased from a manufacturer. There are many forms of Pitot tubes and each user has a preference for his own type.

In the author's estimation, the quickest way to set up a Pitot tube is to drill two holes in a 1½-in. standard plug, to receive ¼-in. pipe, and thread the ends of the holes for ¼-in. pipe. Determine the diameter of the water main, and the internal radius. Cut two pieces of ¼-in. brass pipe, about ½ in. longer than the radius, thus allowing for thread and angular cut. Thread one end of each and cut the other at an angle of about 30 deg. to the axis of the pipe, as illustrated in Fig. 1. Smooth the angular cut with a file, leaving no burrs nor irregularities on the ends. Screw the two tubes into the inside of the plug so that the two openings are in diametrically opposite directions, parallel to the water flow, or pipe axis. Figure 2 shows the completed tube, which can then be screwed into the 1½-in. hole in the main.

From the external openings of the plug, are run the lead lines to the differential gage. This gage is usually simply a glass U-tube of sufficient length to hold the liquid column without being drawn or blown out and strong enough to withstand the pressure of the water. The same is true of the rubber attaching tube, so that it does not burst or blow off the U-tube.

The location of the Pitot tube is most important. While ideal conditions are usually unobtainable, very good results can be gotten with a little discretion. It is usual to place the Pitot tube in the discharge line from the pump where one usually finds a long stretch of straight pipe to give straight-line flow in the main. In multiple pump systems, such is not the case, and valves, bends, etc., interfere. There is no reason why the suction pipe of the pumps cannot be used. The suction line usually drops considerable distance to a well, so that the tube can be inserted close to the pump. An advantage here is that no great pressure is involved; about 5 to 10 in. of mercury vacuum, and ordinary rubber tubing can be used.

Another advantage of the suction line is that in

case the velocity of the water is low, as is usually the case, mercury in the U-tube will give an extremely small reading—fractions of an inch. With the Pitot tube in the suction main, water can be used in the U-tube, colored with a little red ink for clarity, and the connecting lead lines containing air. Such an arrangement magnifies the readings 13 times. Occasionally the rubber tubes should be disconnected and air drawn into the Pitot tube to remove water from the lead lines, which may affect the reading. It is usually most convenient to mount the U-tube with its supporting wooden back directly upon the Pitot tube lead lines, as illustrated in Fig. 3, right on the water main.

Figure 3 illustrates several methods of installation, complete, with the U-tube at the Pitot tube.

It is not necessary to use the device actually to give the quantity of water pumped, if there is any doubt as to the accuracy of such figures. The relative differential pressure readings can be used to denote the efficiency of the pump. If we know that when the pump is in prime condition a certain reading is obtained, the various readings will give corresponding volumes of water pumped. This will indicate clearly when the pump needs overhauling, or when the impeller is failing, and so on. With a good installation, however, the U-tube can be used as a direct manometer for indicating the gallons of water delivered to the system. Herein is given a method of calculation of such delivery:

The usual Pitot tube formula is

$$V = C\sqrt{2\,g\,H}$$

Where

V = velocity, in feet per second,

C = constant of Pitot tube, which for the type shown, is 0.9,

g = acceleration of gravity, 32.2 ft. per second per second,

H = differential reading of U-tube, converted into feet of water.

This differential, H, however, represents that obtained at the center of flow, where the velocity is maximum. This must be converted into average head across the water main, thus taking into account the low velocity

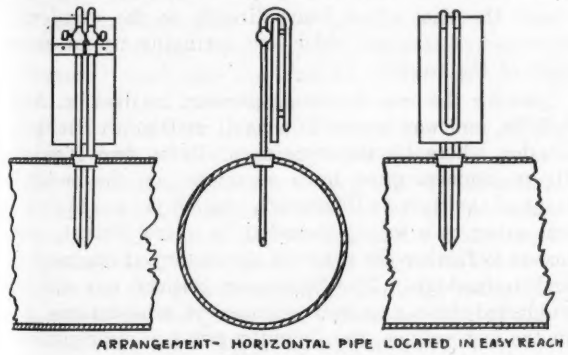

ARRANGEMENT- HORIZONTAL PIPE LOCATED IN EASY REACH
VERTICAL PIPE OR PIPE IN PIT- WITH U-TUBE LOCATED A DISTANCE FROM PITOT TUBE

FIG. 3. METHODS OF INSTALLING PITOT TUBES

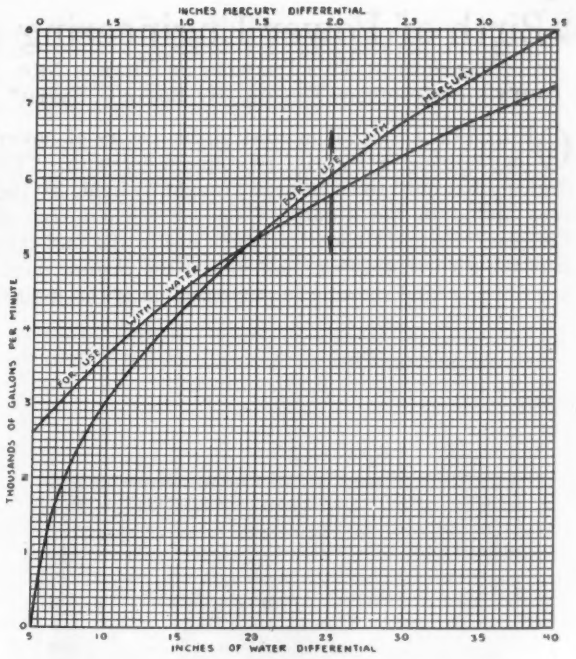



FIG. 4. CALIBRATION CURVE OF PITOT TUBE

of the water rubbing against the surface of the main. According to Rowse (Transactions A.S.M.E.)

$$h = 0.80\ H$$

where h = hypothetical head of flow of average velocity across the main. So that the final formula to be used in actual problems, would be

$$V = 0.9\sqrt{2g\ (.8)\ H} = 6.48\sqrt{H}$$

If "H" is given in inches of water, divide "H" by 12 to get feet of water head, and if given in inches of mercury, multiply H by 1.13 to get feet.

Having thus obtained the velocity in feet per second, multiplying by the area of the main in square feet gives the volume in cubic feet per second, and multiplying by 7.48 gives gallons per second.

The accompanying curve illustrates an actual calibration of a Pitot tube as placed in the 16-in. suction line of a centrifugal pump.

By the purchase of a recording differential gage, as manufactured by the standard instrument makers, at a price of about $90.00, a recording flow meter can be obtained by using the Pitot tube in the main, at very little cost compared with the prices of standard flow meters.

As an example of the calculation of the flow, by means of the Pitot tube, illustrating the derivation of the curves, suppose a differential pressure of 2 in. of mercury was obtained, which would correspond to almost 27½ in. of water.

Using the formula stated above:

$$V = 6.48\sqrt{\left\{\frac{2\text{ in. mercury} \times 13.6\text{ in. water}}{12\text{ in. water per foot}}\right\}}$$

$= 6.48 \times 1.5$ or 9.72 ft. per sec. velocity.

Volume = Area × velocity (using 16-in. water main)

= 1.4 sq. ft. × 9.72 ft. = 13.6 cu. ft. per sec.

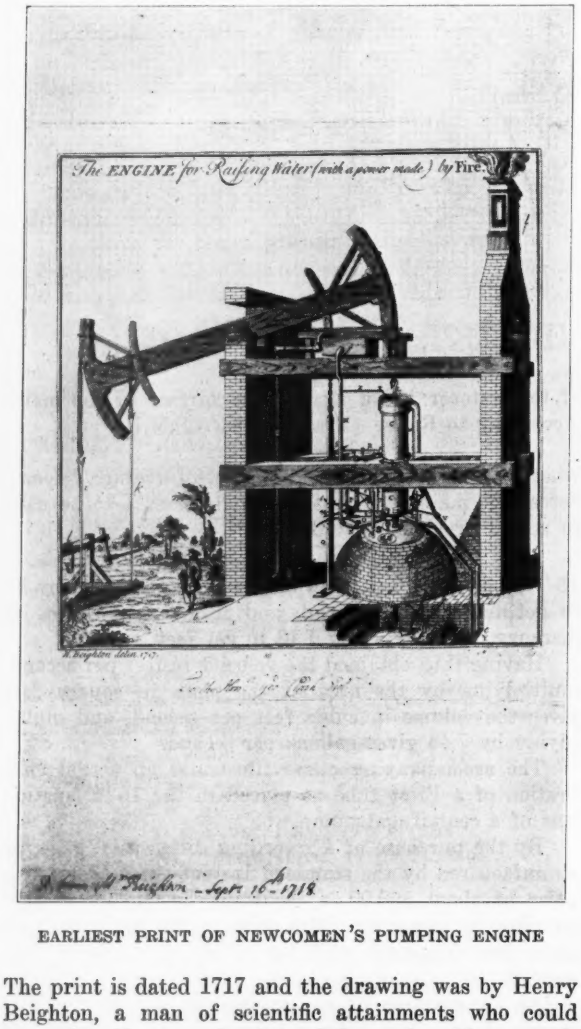
= 6100 gal. per min.

This is the quantity found on the curve for a differential of either 2 in. mercury or 27½ in. water.

# Birth of Power Engineering

IT IS RECORDED IN THIS DRAWING OF THOMAS NEWCOMEN'S ATMOSPHERIC ENGINE. BY EDGAR C. SMITH*

OF QUITE UNIQUE interest in the history of power engineering is the print reproduced herewith. This drawing has only recently been brought to light, having been found in the library of one of the old Oxford Colleges. Its great historical value lies in the fact that it is the earliest drawing, and indeed the earliest document of any kind showing the construction of the engine.




EARLIEST PRINT OF NEWCOMEN'S PUMPING ENGINE

The print is dated 1717 and the drawing was by Henry Beighton, a man of scientific attainments who could appreciate the several points of the engine. Newcomen's first engine was probably put into action in 1712 in Staffordshire. There is a print of this but it is dated 1719, 2 yr. after the Beighton drawing. How the Newcomen engine worked has been explained over and over again in historical works on the steam engine but it is, perhaps, worth recalling that Newcomen did not invent the boiler, the cylinder, the piston or the idea of condensation but he was the first to combine these things in a practical manner and put his piston on the end of a beam, thus giving us what remained the standard form of engine for about a century and a half. With modifications, Newcomen engines continued to be constructed throughout the eighteenth century even after Watt had made his improvements. The Newcomen model now in the Museum at Glasgow University is the one which was given to Watt to repair and thus made him a great power engineer. But Watt's first separate condenser model is in the Science Museum at South Kensington, London.

At one time, little was known about Newcomen but various engineers, notably Rhys Jenkins, late of the British Patent Office, have gleaned much information and the outline of his story is now at least familiar. The Newcomen family came from Lincolnshire but, when the Pilgrim fathers sailed from Dartmouth, there was a branch of the family in that district. Newcomen himself was born in Dartmouth and was baptised in Dartmouth Church in 1663. His contemporary, Savery, was also a Devonshire man and thus power engineering had its birth in the county of Hawkins and Drake.

Savery's patent, which was the first steam engine patent, was granted in 1698 and the joint work of Savery and Newcomen centres around this. Though statements are made to the contrary, no patent was issued to Newcomen.

As already remarked, the first Newcomen engine was set to work in 1712. Four years later the first advertisement regarding the engine was published. This ran "Whereas the invention of raising water by the impellent force of fire, authorized by Parliament, is lately brought to the greatest perfection, and all sorts of mines, etc., may be thereby drained and water raised to any height with more ease and less charge than by the other methods hitherto used, as is sufficiently demonstrated by divers' engines of this invention now at work in the several counties of Stafford, Warwick, Cornwall and Flint....." This wording may well raise a smile when it is recalled that the engine, which had been brought to "the greatest perfection," used something like 20 to 25 lb. of coal per horsepower per hour. But Newcomen's engine marks the first step on the road which led to the industrial revolution and he it was who blazed the trial which leads directly to the wonderful super-power stations which are springing up in every part of the world.

As for the once forgotten pioneer, he died on Aug. 5, 1729, and was buried in a vault in Bunhill Fields in London where lie the remains of Defoe and Bunyan. He is commemorated by a monument on the embankment of the river at Dartmouth while 6 yr. ago his name was given to a society founded by a few British engineeers to further the study of the history of engineering and technology. The Newcomen Society has already published four excellent volumes of transactions and in the last volume, the Beighton print is appropriately reproduced as a frontispiece. Moreover the society has arranged to supply copies at small cost to any one wishing for them.

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WATER HAMMER will never occur in a properly drained steam line.

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CLEANLINESS and orderliness in a plant are indications of efficiency.

*Official Lecturer to the Science Museum, South Kensington, London.

# Recent Developments in Coal Burning

Forced Draft Chain Grate and Pulverized Coal Burners Used Successfully with Middle-West Coals. By F. S. Collins*

THE LAST seven years represent what may in the Middle-West be called the Forced Draft Chain Grate Era, and although there are many indications that this is now approaching its decline, it may be of interest to comment upon the rapid development of this class of apparatus to meet the increasing demand for high evaporative rates, flexibility and control of combustion. The most notable improvement undoubtedly has been the application of forced draft to the fuel bed by means of isolated wind-boxes or compartments, enabling the operator to control the ignition, the burning off of the volatile gases and the final reduction to incombustible refuse, to the best advantage.

This application increased the coal burning capacity per square foot of grate surface from a former maximum of about 30 lb. to 60 or 65 lb. without excessive ash pit loss. Evaporative rates up to 350 per cent of normal rating became ordinary practice, and stoker capacity yielded up its place as the limiting factor of furnace capacity, to the inability of furnace refractories to withstand the very high temperatures which were established, not so much as a result of forced combustion, but as a consequence of the necessity of reducing the excess air to the minimum, and thereby securing efficiency and avoiding high draft losses at the same time. With these high temperatures, however, the worst feature of the Middle-West bituminous coal, slag became greatly aggravated.

There has recently been a tendency to swing back from the very high evaporative rates to a medium of from 225 to 275 per cent of rating, with a consequent reduction of the troubles referred to, and it is a fine point as to just where the saving in boiler and building investment due to high steaming rates may offset the additional maintenance and outage which are the attendant evils when burning low grade western coals on forced draft stokers.

While the underfeed stoker is comparatively little used in the Middle-West owing to the prevalence of free-burning coals and the scarcity of low-ash, coking coal to which the underfeed stoker is so well adapted, it is necessary to bear in mind the improvements which have been made in this type of machine also.

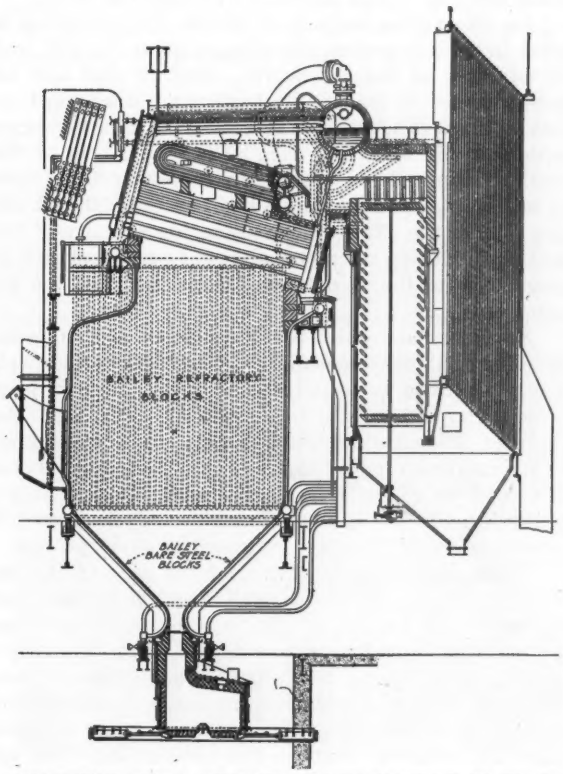
The vertical depth of the rotary ash discharge has reduced the ash pit loss to a fraction of one per cent. The new system of air distribution and the thorough mixing of air and fuel obtained have improved the combustion, while the greatly increased length of the stoker has increased the weight of coal burned per foot of furnace width to such a degree that the maximum evaporative rate attained was equivalent to 603 per cent of boiler rating.

Another feature which complicates the stoker situation is the application of preheated air. This is in a sense a paradox, for while the preheating of the air for combustion is unquestionably an advance in the art so far that it permits of the recovery of waste heat from the stack gases beyond the reach of the water economizer, and while it also increases the recovery of latent heat of the steam by steam extraction from the turbine without increasing the stack temperature due to the increased feed water temperature, it also imposes severe mechanical strains on the stoker due to unequal heating.

*Mechanical Engineer with Sargent & Lundy. Abstract of Paper read before the Midwest Paper Conference.

### Difficulties Solved by Pulverized Coal Burning

Development of the principle of burning coal in pulverized form has opened an avenue of relief from




PULVERIZED FUEL FURNACE AT THE CALUMET STATION

these and other difficulties, and is in my mind the most important advance of this decade in the art of steam generation, although in the same class should be mentioned the water cooled furnace.

It is safe to say that in all of the earlier power plant installations the pulverizing equipment was arranged as a central preparation plant. This arrangement, although it has many advantages, and is producing excellent results, is somewhat too expensive and complicated to justify its use in small plants or even in large ones which burn a cheap grade of coal.

This situation has resulted in the development of the unit pulverizer system in which the raw coal is fed direct from storage to the mill and thence to the burners, without the use of pulverized fuel storage bins or feeders. It does not necessarily except the coal drier, which may be operated by waste heat, by hot air from the air preheater or by steam either from the auxiliary exhaust or extracted from the main turbines. It is beginning

to be recognized, however, that the drying of coal before pulverizing is neither as essential nor as desirable as we formerly believed. There are some types of unit mill which will handle wet coal with complete success, and while the process absorbs more power per ton ground than does the grinding of dry coal, the difference between 9 per cent and 15 per cent moisture content does not increase the total station auxiliary power more than 1½ per cent. This is more than offset by the losses due to the drying process, which include the fixed charges on the drying equipment, the loss of coal dust entrained with the gases from the drier, the loss of coal dust discharged from mill vents, and the loss due to the volatiles released by low temperature distillation at or above 300 deg. F. and carried off through the vents.

An alternative method of partial drying which is much in use is to preheat the primary air to the mill, and in this case no loss is involved, since all dust and all gases released in the mill by heating are discharged direct to the coal burners. The amount of this air varies with unit mill operation from 30 to 70 per cent of the total air required for combustion, according to the type of mill used, and when heated to between 300 and 350 deg. F. has the effect of increasing the capacity of the mill and reducing the power absorbed per ton of coal in proportion to the volume and temperature of the air supplied.

Secondary air, which is the remainder of that necessary for combustion, is supplied either by a forced draft fan or is drawn into the furnaces by the negative pressure due to the stack or to the induced draft fan. As, however, it is advantageous to preheat the secondary air to the maximum, either by using it as a cooling medium for the furnace walls or by passing it through an air preheater, the forced draft fan is usually necessary to overcome the friction losses involved in either process.

When the air is introduced at the back of the setting, led through the side wall ducts and finally admitted to the furnace at the front or sides, the flame propagation is prolonged to a degree which necessitates a very large furnace and probably a reversal of flame travel in order to prevent impingement on the walls or on the boiler tubes, as well as to provide the required time for complete mixture and combustion. The admission of all of the air at or around the burner on the other hand is found to produce a short flame, a localized "hot spot," and calls for a relatively small furnace.

With the use of Illinois coal the most serious problem involved is the amount and nature of the ash and a comparison of the amount is shown in the following table:

| Kind of Coal | Kincaid | W. Va. |
|---|---|---|
| Per cent ash | 13.5 | 7.5 |
| Coal per kw-hr. (lb.) | 1.5 | 1.0 |
| Ash per kw-hr. (lb.) | 0.202 | 0.075 |

There is, therefore, almost three times the ash to contend with from the Illinois coal as from the West Virginia but in addition the former has some unfavorable characteristics. It has a low fusing temperature, averaging 1940 deg. F. and it contains a high percentage of sulphur and of iron. High percentage of ash is significant in a number of ways. It makes the pulverizing process more difficult and greatly increases the mill horsepower per ton of coal, or conversely decreases the mill capacity and shortens the life of the wearing parts.

Iron and sulphur in the ash combine with the elements of the furnace brick to the destruction of the latter.

But the formation of slag is perhaps one of the worst characteristics of the high ash Western coals. The average fusion point of the ash is low, as has already been noted, being in the neighborhood of 1940 deg. F. The molten ash is carried, therefore, through the first few rows of tubes and deposits in the form of slag above the drop leg. The dust carries up into the superheater and into the upper bank of tubes.

With pulverized coal the dust problem assumes larger proportions, for whereas with stoker firing perhaps 15 to 20 per cent of the ash is carried up through the tubes, with pulverized coal from 75 to 80 per cent will pass through the boiler and subsequent gas passages.

It must be noted, however, that of the finely divided ash of pulverized coal a much greater proportion will be carried entirely through the boiler unit and up the stack than is the case with the ash from a stoker, so that in spite of the much greater volume starting upward, the actual fouling of the surfaces will probably be less with the pulverized fuel. Furthermore, it seems probable that with pulverized coal the ash will be more thoroughly burned out than with stoker firing, due to the much greater surface exposed to oxidation over a given period of time.

I believe that the water cooled furnace wall is the best present solution to the problem of maintaining high evaporative rates, together with the low excess air necessary to efficiency, without excessive furnace maintenance.

An interesting application of pulverized fuel to central station use has recently been made in the Calumet Station of the Commonwealth Edison Co.

This consists of a Babcock & Wilcox boiler of the horizontal cross-drum type, but of special design, having a heating surface of 5805 sq. ft. The boiler is equipped with a Babcock & Wilcox steaming-type economizer of 8850 sq. ft., superheater of 5017 sq. ft., and a Babcock & Wilcox air-heater of 41,700 sq. ft. external heating surface and 37,650 sq. ft. internal heating surface. The furnace volume is 11,200 cu. ft. and it is completely water cooled. The exposed surface of the Bailey Blocks is 3242 sq. ft.

This is in no sense an example of a unit installation. The raw coal is fed to an air-heated drier, thence to a 70-in. Fuller ball mill, from which it is discharged to a small pulverized fuel bin. From the bin it descends by gravity through a weighing hopper to the Bailey feeders, and thence to the burners. The principal points of interest observed so far are the flexibility and great steaming capacity of the installation. The installation is to some extent experimental, and yet during a recent trial an evaporative rate of 300,000 lb. per hr. was reached for a short time. At this rate 30,000 B.t.u. were released per cubic foot of furnace volume per hour, and the indications were that this is by no means the limit of this boiler unit. The limiting factor at this particular time was the capacity of the boiler feed pump against the excess friction head developed by the rate of feed, and it was not possible to run the boiler long enough under these conditions to determine whether the slag problem would become formidable or not.

Referring again, however, to the difference between

the Illinois coal and the higher grade coals it should be remembered that West Virginia coal averages about 13,600 B.t.u. per lb., while Kincaid coal runs close to 10,000 B.t.u. per lb. The Columbia Power Plant is operating on about 12,700 B.t.u. per kw-hr. of output. Crawford Avenue will operate on about 15,250, with chain grate stokers. If Crawford Avenue were operating on pulverized coal, the station might reasonably be expected to produce a kilowatt-hour for not more than 14,400 B.t.u., or in other words, it would be approximately ten per cent less economical than Columbia Power. Given equal load factors, the difference is chargeable almost entirely to the difference in the characteristics of the two coals. The high moisture, ash and hydrogen content all constitute definite losses, but the real disadvantage of the Kincaid coal is that it would require about 50 per cent more pulverizing equipment, it would require more furnace volume and more fan and mill power for the same steam output than does the Columbia Station. In addition, the presence of 13 or 14 per cent of ash makes the coal harder to grind.

It is clear, therefore, that the difference in investment, and, therefore, in the fixed charges, is a serious consideration when comparing the results of burning Kincaid coal against a high grade coal.

Some months ago I witnessed a test at McAlester, Oklahoma, in which Texas lignite was pulverized in a unit mill and burned with very good results. The lignite had a total moisture content of 37 per cent, of which about 15 per cent was inherent moisture, and was fed to the mill as received. This, of course, reduced the mill capacity to a very low figure in terms of actual combustible, but the pulverization was good and the subsequent combustion excellent, despite the fact that neither the primary air to the mill nor the secondary air to the burner was preheated in any way.

# Large Diesel Engine for the Seminole

DIESEL OIL ENGINE OF 3300 HP. RECENTLY BUILT FOR THE UNITED STATES SHIPPING BOARD IS SUITABLE FOR BOTH MARINE AND STATIONARY PRACTICE

ONE OF THE largest Diesel engines built to date in America, has just been completed by the Hooven, Owens, Rentschler Co. of Hamilton, Ohio. This engine, which is of the Hamilton-M. A. N. Diesel type, is of 4-cylinder, double-acting, 2-stroke-cycle design. The diameter of the cylinders is 27½ in.; the stroke, 47¼ in. It will develop 3300 hp. at 95 r.p.m. This power, however, can be increased to 4500 hp. by running the engine at maximum speed. The installation is being made in the "Seminole," a 9600-t. cargo ship and will form part of the conversion program in which the Shipping Board has been engaged during the past 2 yr. Although built for marine service, this engine is equally adaptable for stationary practice.

### METHOD OF ADMITTING SCAVENGING AIR

In addition to the four power cylinders, a 3-stage compressor for air injection and a twin scavenging pump for supplying the scavenging air for the power cylinders, are directly connected to the crankshaft. The engine operates under the M.A.N. system of scavenging. Each liner has two sets of ports on the same side; one directly above the other. The lower ports are the scavenging ports; the air being blown in across the top of the piston and forced to the top of the cylinder on the head end, then exhausted through the exhaust ports which lie directly above the scavenging ports. The angles of the ports directing the air are such as to direct the air current to every part of the cylinder. The crank end ports function in a similar manner on that part of the cylinder.

### RIGIDITY OF FRAME

Rigidity of construction is secured through the use of wide and deep box sections in the bedplate and heavy housings, which are fastened on top of the bedplate. These housings are bolted to the top of the lower entabulature, which is of heavy, cast-iron box section and extends the entire length of the engine. To the upper face of these entablatures are set the cylinder columns which again tie into the upper entablatures.

The upper entablature is also of a deep box section. It extends the entire length of the engine. In addition to all the joints being held by bolts, there are four tie bolts for each cylinder, which extend from the bottom

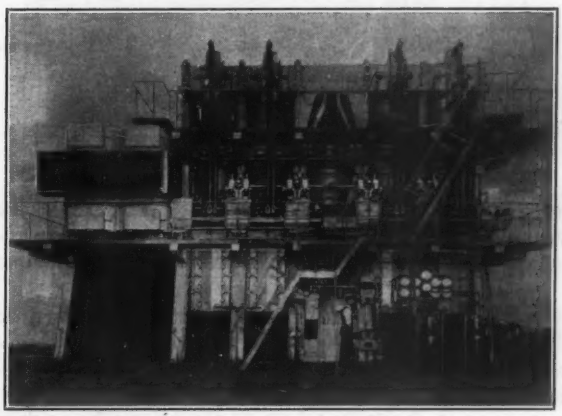


FIG. 1. 3300-HP., 4-CYLINDER, DOUBLE-ACTING, 2-CYCLE HAMILTON-M. A. N. DIESEL OIL ENGINE BUILT BY THE HOOVEN, OWENS, RENTSCHLER COMPANY FOR THE UNITED STATES SHIPPING BOARD

of the bedplate to the upper part of the upper entablature. The purpose of this construction is to stiffen the structure by providing tie rods for the absorption of tensile stresses and tying the various members of the frame together both athwart ship and fore and aft so as to give such rigidity to the engine that vibration will be eliminated, at the same time providing freedom of expansion and contraction in those working parts, such as cylinder liners, that are subjected to rapid changes of temperature.

Cylinders are set between the columns. The cylinder liners are made in halves—one for the upper end and the other for the lower. The cylinder jackets, are bolted to the lower entablatures and to the upper entablatures the upper cylinder liner is fastened. The liners are in

halves, having an opening in the center of the cylinders so as to allow freedom of expansion. The joint is staggered so as to avoid "breathing" of the piston rings. Stuffing boxes provide for expansion while guiding the liner.

Circulation of cooling water for the piston is provided by coring out the piston and using a hollow piston rod. Telescopic piping, driven from the crosshead

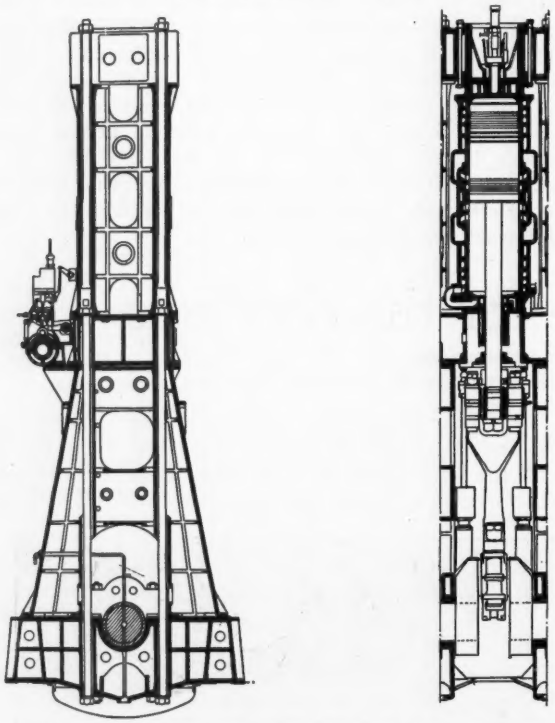


FIG. 2. SHOWING FRAME CONSTRUCTION AND MANNER IN WHICH ENTABLATURE TIES THE SEVERAL CYLINDERS TOGETHER AND IN WHICH TIE BOLTS STIFFEN THE STRUCTURE

of the engine and working through stuffing boxes into air chambers in order to seal the water against contact with the lubricating oil, is provided for the admission and discharge of the cooling water. The crankshaft is of the built-up type and the connecting rod of conventional design. The crosshead is of the single slipper type, operating in guides bolted to the frames so as to take the thrust when running astern. The main bearings are made with round shells; shims are provided for adjustment in all parts subjected to wear.

### Materials Used in Construction

Cast iron is used for the structural parts of the engine. The liners are made of special cast iron of sufficient hardness to resist wear. The cylinder heads are made of steel castings and made in sections so as to provide satisfactory water circulation and for expansion and contraction due to temperature changes. The piston heads are also of steel casting and are water cooled.

Air compression for the injection of fuel is provided by a 3-stage compressor driven from the crankshaft. The compressor pistons are of step design with the high pressure on top, the low pressure in the middle and the intermediate at the lower end. The air is cooled between the stages by coolers which are provided with water separators so as to draw off the moisture from the air between stages.

Scavenging air is supplied at from 1½ lb. to 2 lb. by scavenging pumps which are of the double-acting type. They have plate valves especially designed for low pressure and are driven by connection with the main crossheads. The fuel and starting valves for both the upper and lower parts of the cylinders, are driven from the camshaft which is located in the middle of the engine and fastened to the lower entablature. The camshaft receives its motion from the main shaft by a set of spur gears and bevel gears.

Fuel is injected into the cylinders under a pressure of from 750 to 1000 lb. One fuel valve is centrally located in the upper cylinder head and four fuel valves are situated radially in the lower cylinder head as shown at F in Fig. 3. The fuel pumps are located on brackets directly above the camshaft and are driven from cams on the camshaft. This feature is novel. It so times the fuel pumps that close regulation of the engine is possible. There is a fuel plunger for each upper and lower end of the cylinders.

### Control and Regulation

Reversing is accomplished by moving the camshaft longitudinally. A complete extra set of cams is provided on the camshaft for the astern motion. The camshaft is moved by means of a ram which is operated by compressed air. The control gear for the engine is located on the lower platform and consists of one lever which controls the starting, reversing and stopping of the engine. The operation is carried on by means of high pressure air to the main starting valve and revers-

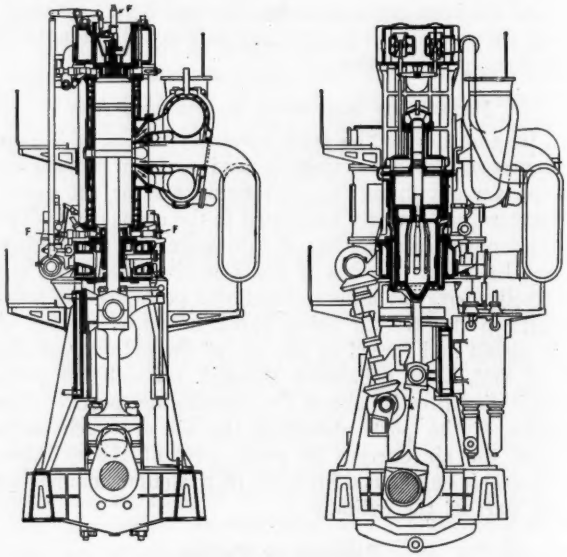



FIG. 3. SHOWING DETAILS OF CONSTRUCTION OF ENGINES AND 3-STAGE AIR COMPRESSOR

ing gear. In addition there are located on the operating platform, one lever for regulating the amount of fuel and also one lever for operating the amount of air for the air compressor. The injection air pressure is controlled by a small handwheel.

An over-speed "Aspinall" governor is provided. The regulation of the engine is accomplished by bypassing fuel served by the fuel pump. The starting valves are automatically cut out as soon as the engine has attained sufficient momentum to compress the air high enough to cause ignition. The entire engine is enclosed and subject to forced lubrication and a complete system of water cooling so as to permit of proper circuit and velocity to the cooling water.

The engine, including scavenging pump and compressor, weighs approximately 850,000 lb. The length of the engine is 40 ft. The width is 15 ft. The height above the center line of the shaft is 28 ft.

### Large and Efficient Foreign Examples

Although the first engine of this design was completed only about a year ago, there are already under construction in this country and abroad, engines to the extent of 77,000 b.hp. Included in this program is the "Augustus," which will be the largest motorship in the world, recently launched in Italy. This vessel is equipped with four 6-cylinder M.A.N. main engines, each developing 7000 hp.

The most notable example of this type of engine is the 15,000-hp. engine installed in the Hamburg Electric Light Station, Hamburg, Germany. This engine is of identical design with the one above described except that the cylinder sizes are larger, being 34-in. dia. by 60-in. stroke and the engine consists of nine cylinders with attached compressors, but with separate scavenging pumps. This engine was recently subjected to fuel tests and at full load, the fuel consumption per b.hp. was 0.372 lb., excluding the scavenging blower. It was found to be 0.394 lb. per b.hp. including the scavenging blower. The thermal efficiency, referred to b.hp., was found to be 37.5 per cent excluding the scavenging blower or 35.7 per cent including the blower. This engine has been in satisfactory operation for the past seven months.

## Phases of the Lignite Problem

SEVERAL methods of approach to the problem of the successful utilization of lignite are possible, states the Bureau of Mines, Department of Commerce. Any process whereby lignite can be profitably converted into more valuable and salable products will help to develop this latent source of energy. Accordingly an investigator might well study any of the following phases of the lignite problem:

A cheap means for completely gasifying lignite, including an improved method of making producer gas and a suitable method for making water gas.

A means for producing a solid fuel other than by briquetting the carbonized lignite.

The possibility of developing a means of coking lignite.

The commercial applicability of the carbonizing and briquetting process and its relation to by-products and methods for plant control.

A method for producing valuable crude liquid products by the distillation of lignite, with attention to the influence of changes in conditions, such as pressure, temperature and rate of heating on the character, quantity and quality of the resulting products.

The possibility of hydrogenating or otherwise preparing liquid or soluble products direct from lignite.

Each of these studies offers a promising field, but only the carbonizing and briquetting process holds positive assurance that the experiments will end with a satisfactory solid domestic fuel. Some of these problems when solved would be more or less of local interest and not generally applicable to the large lignite deposits in different parts of the United States.

## High Steam Pressure for St. Louis Pumping Station

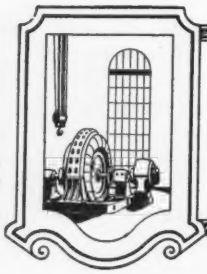
CONSTRUCTION work on St. Louis' newest and largest pumping station has progressed to the point where the pumps have been ordered and it is expected that the new station will be in service by the latter part of 1928. Water taken from the Missouri River at Howard's Bend will be treated and then pumped 9 mi. through a 54-in. main to the new 1000-million gal. reservoir now being completed at the highest point in St. Louis County.

LOW HEAD PUMP PIT AND INTAKE FOR ST. LOUIS' NEW PUMPING STATION AT HOWARD BEND ON THE MISSOURI RIVER

Three low head pumps will be installed to pump against a total head of 40 ft. Two of these will have a capacity of 50 million gal. per day and one a capacity of 100 million gal. per day, while the two high head pumps will handle from 30 to 40 million gal. per day against a total head of 350 ft. This will be made up of a static head of 280 ft. and a variable friction head of about 70 ft. at the normal capacity of the pump.

These pumps are all De Laval Turbine driven centrifugal units, designed to operate under steam conditions of 300 lb. and 225 deg. superheat. Steam will be supplied by four 6500-sq. ft. Heine water-tube boilers designed for a maximum pressure of 400 lb. Forced draft chain grate stokers will be used and the boilers equipped with Ljungstrom preheaters.

Electric power for the cranes and auxiliaries will be supplied by two 250-kw. non-condensing turbo-generators. The station, when completed, will be the leading pumping station of the city, and by taking advantage of high pressure and modern power plant equipment will be a distinct advance in pumping station design.



# ELECTRICAL MACHINERY FOR LIGHT AND POWER

# Interlocked Mechanism for Tap Changers

A Description of a Mechanism Developed to Prevent Transformers Being Connected to Line While Taps Are Being Changed. By R. M. Field*

TAP CHANGERS (or ratio adjustors) are mechanisms used for the purpose of changing the taps of a transformer by mechanical means, thus avoiding the removal of manhole covers to change internal connections on the terminal board located under the oil of the transformer.

Such devices are usually operated from a handwheel located on the transformer cover. When frequent changes of taps are to be made this method becomes cumbersome as the operator must climb to the top of the transformer to make a change of taps. A new type of operating mechanism has been recently developed for operation from a handwheel located at a convenient height on the side of the tank. This not only makes for greater convenience but increases the safety to the operator.

Figure 1 shows an interior view of a 3-phase transformer with three tap changers which are operated by a handwheel located at a convenient height on the side of the transformer. The insulated shaft extending between the tap contacts and the driving mechanism in the top of the tank has its insulation creapage surface increased by means of a disk of insulation moulded integral with the shaft, thus increasing its insulation strength. The internal operating mechanism, consists of worm gears, universal joints, and a steel drive shaft which is brought through a stuffing box on the side of the tank to bevel gears. This mechanism is supported by two channel irons extending across the top of the tank. A vertical shaft connects the internal mechanism to the handwheel. The required torque at the handwheel is reduced to a desired value by the use of reduction gears. As the three tap changers are all connected to the same drive shaft, tap changes are made simultaneously in all three phases.

Figure 2 shows the position indicator assembly of

*Transformer Engineering Dept., Westinghouse Electric and Mfg. Co.

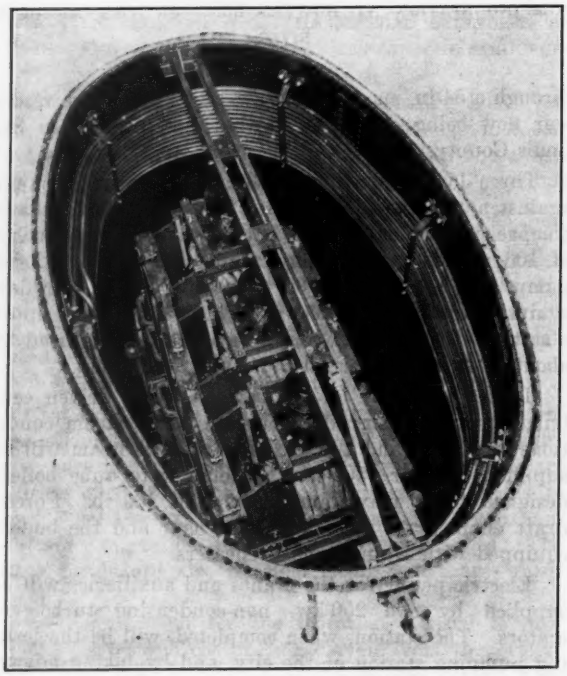


FIG. 1. INTERIOR VIEW OF 3-PHASE TRANSFORMER WITH THREE TAP CHANGERS, SHOWING INSULATED OPERATING ROD

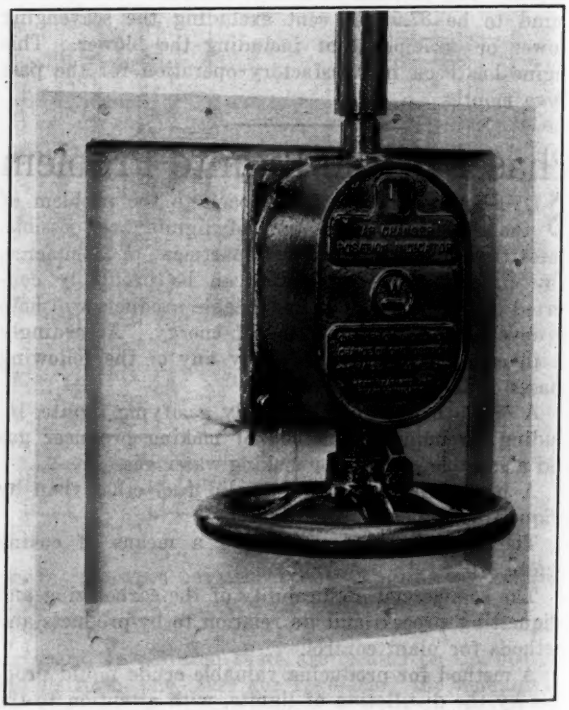


FIG. 2. THE POSITION INDICATOR AND OPERATING HANDWHEEL OF TAP CHANGING EQUIPMENT

the mechanism, the release lever and the handwheel. The design is such that one complete turn of the handwheel makes one change of taps. The tap position is indicated by a position number which is visible when the tap changer is on a tap position. "Off" positions are indicated in a similar manner by the word "Off."

To make a change of taps, the transformer must first be disconnected from the line. The mechanism which is normally locked in a tap position by the release lever marked "PUSH" is unlocked by pressing on this lever. By rotating the handwheel in the proper direction, the desired change of taps may be made.

To make more than one change of taps at the same time, the release lever is pressed while passing an intermediate tap position.

The release lever may be provided with a padlock so the mechanism may be locked on a tap position. After the change of taps, the transformer may again be connected to the line.

### Interlocked Operating Mechanism

In some cases it may be desirable to arrange the operating mechanism of the tap changer so that it is impossible for the operator to change taps unless the transformer has been properly disconnected from the line.

In addition, interlocking may be desired to prevent energizing the transformer with the tap changer off an operating position.

In such an installation a metal box is provided which is bolted directly to the transformer tank and entirely encloses the handwheel, release lever, and position indicator, as shown in Figure 3. This box has a small window so the position number of the tap changer is visible with the door closed. An interlocked door gives access to the handwheel to make a change of taps. Figure 4 shows a method of wiring the interlocked mechanism. All wiring of the mechanism is brought to a terminal block located inside the box, to which the conduits leading to the power supply and auxiliary switches of the circuit breakers are attached.

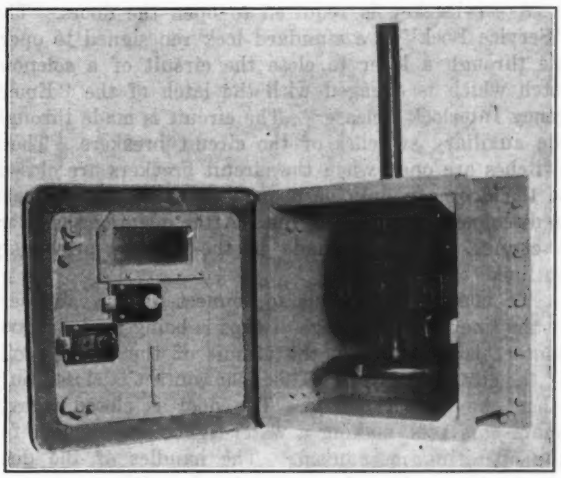


FIG. 3. POSITION INDICATOR AND OPERATING MECHANISM INSTALLED WITH INTERLOCKING MECHANISM

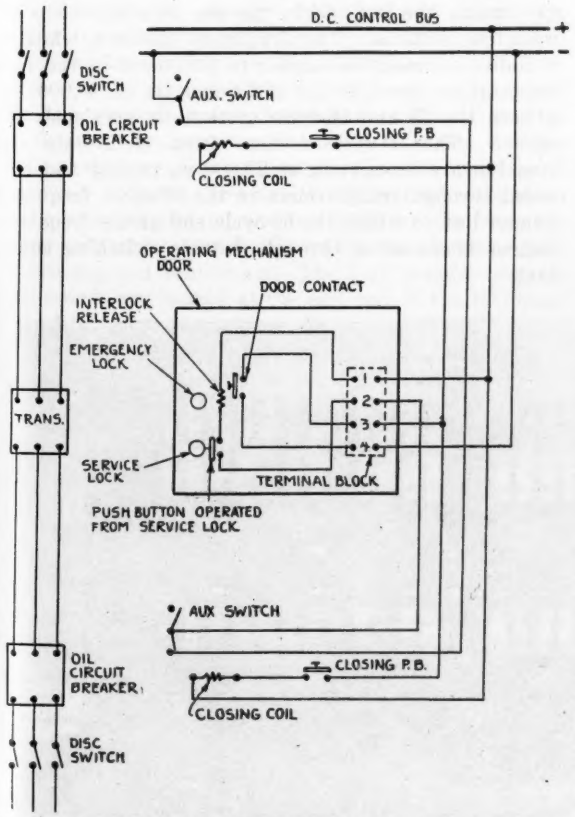



FIG. 4. DIAGRAM OF CONNECTIONS FOR TAP CHANGER INTERLOCKED OPERATING MECHANISM

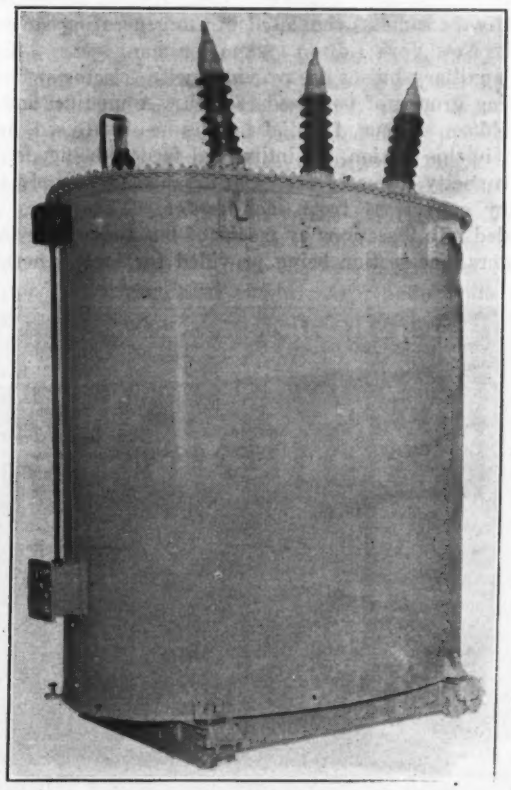


FIG. 5. A 3-PHASE TRANSFORMER EQUIPPED WITH TAP CHANGERS AND INTERLOCKED OPERATING MECHANISM

A service key is required to open the doors. The "Service Lock" is a standard lock redesigned to operate through a lever to close the circuit of a solenoid latch which is engaged with the latch of the "Emergency Interlock Release." The circuit is made through the auxiliary switches of the circuit breakers. These switches are open when the circuit breakers are closed, so the door can only be opened when the transformer is disconnected from the line. After opening the door, a change of taps is made in the manner previously outlined.

To make it impossible to connect the transformers to the line while a change of taps is being made, a door contact is provided in the circuit of the closing coils of the circuit breakers. This door contact is closed only when the door is closed. The door is closed tightly against gaskets, making a water-tight compartment for the operating mechanism. The handles of the door should always be left in the closed position.

To safeguard against the transformer being connected to the line with the tap changer "off" position, a projection is placed on the door which engages with a slot in the handwheel when the tap changer is on a tap position. If the tap changer is accidentally left on an "off" position, the projection on the door will not engage with the slot in the handwheel, so the door cannot close and the closing coil of the circuit breaker cannot be energized until the tap changer is moved to a tap position and the door closed.

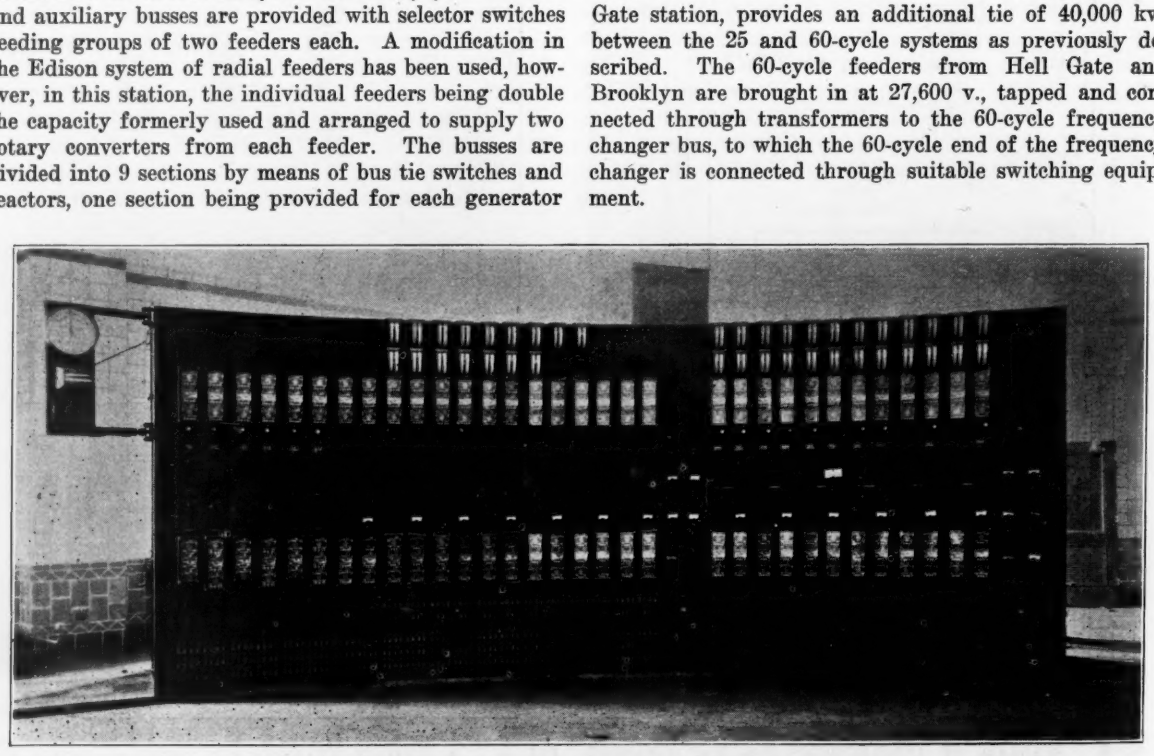
An "Emergency" key is provided which permits access to the mechanism under any condition. This key, when used in conjunction with the "Service" key, allows the door to be opened even though the release circuits are not energized. The "Emergency" key, of course, is not used under ordinary conditions.

This type of interlocked operating mechanism has many advantages over the operating mechanism located on the top of the tank, or the simple operating mechanism located on the side of the tank. Besides the convenience and safety which it provides to the operator, it also provides protection to the transformer, since it is impossible to make a change of taps while the transformer is connected to the line, or to connect the transformer to the line while the change of taps is being made, or to excite the transformer with the tap changer not on an operating position.

# Electrical Features of East River Station

### High Capacity Breakers, Novel Mechanism and Methods of Insulation Are a Few of the Many Interesting Electrical Features of East River

EXAMINATION of the single line wiring of the electrical system of East River Station, the mechanical features of which are described in the leading article of this issue, shows that the system of connections used is the same as that used in the generating stations of the New York Edison system for many years. Main and auxiliary busses are provided with selector switches feeding groups of two feeders each. A modification in the Edison system of radial feeders has been used, however, in this station, the individual feeders being double the capacity formerly used and arranged to supply two rotary converters from each feeder. The busses are divided into 9 sections by means of bus tie switches and reactors, one section being provided for each generator and twelve feeders. In order to preserve the integrity of the busses and limit the short circuit current, current limiting reactors are provided on all circuits entering and leaving the bus and in the bus tie connections between bus sections. The frequency changer, which is an induction machine similar to that used in the Hell Gate station, provides an additional tie of 40,000 kw. between the 25 and 60-cycle systems as previously described. The 60-cycle feeders from Hell Gate and Brooklyn are brought in at 27,600 v., tapped and connected through transformers to the 60-cycle frequency changer bus, to which the 60-cycle end of the frequency changer is connected through suitable switching equipment.



Main Feeder Control Panels at East River

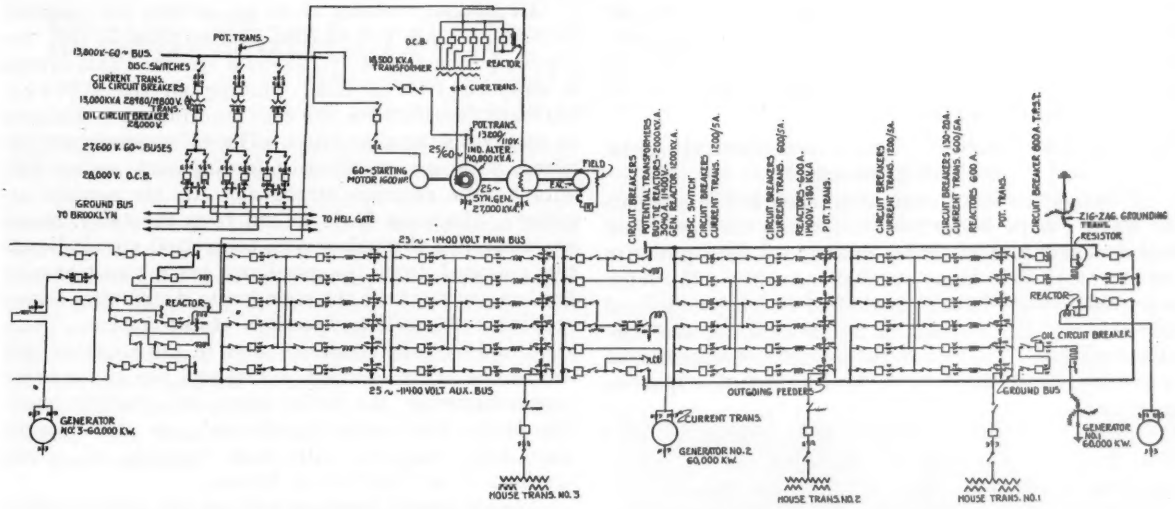



FIG. 1. SINGLE LINE DIAGRAM OF THE MAIN A.C. CONNECTIONS OF GENERATORS NOS. 1 AND 2 AND FREQUENCY CHANGER. CONNECTIONS FOR REMAINING GENERATORS WILL BE SIMILAR

### Vertical Isolated Phase System Used

The electrical galleries are designed on the isolated phase principle; the phases being on three floors separated vertically with the operating mechanisms above the third floor. On the ground floor of the electrical galleries are located the 60-cycle transformers and switching equipment for the frequency changer and the transformers and switching equipment for the station auxiliaries. The mezzanine floor immediately over the ground floor contains the storage batteries and frequency changer tap changing equipment. On the second floor are located the auxiliary control switchboards and motor generators, the main generator and frequency changer runs, the grounding transformers and the oil testing and filtering equipment. The main 11,000-v. busses, switching equipment and reactors are located on the next three floors. Above these are the operating mechanism for the switches and on the top floor are the blowers, heating coils and air washers used for the electrical gallery heating and ventilation. The high tension control switchboards are located at the east end of the building on the fifth floor overlooking the turbine room.

Oil circuit breakers used throughout the station for the high tension connections are of the dead tank type, those used for the 60-cycle connections being arranged with phases adjacent while those used on the 11,400-v., 25-cycle system are arranged with the phases segregated. Due to the concentration of power on the main busses in this station, it was found necessary to design oil circuit breakers of a greater interrupting capacity than had ever been built before. All generator, bus tie and feeder oil circuit breakers are designed with an interrupting capacity of 1,500,000 kv.a. The feeder oil circuit breakers have an interrupting capacity of over 500,000 kv.a. In order to provide for prompt inspection of any switch, motor operated trucks are provided by means of which the tanks on a breaker can be lowered in less than five minutes. Interlocking features are provided, however, so that the switch tanks cannot be lowered unless the disconnecting switches for that breaker have been opened. All of the high tension oil circuit breakers are operated by means of the newly developed motor mechanism which operates by centrifugal action. This type of mechanism provides a much smoother operation of the breaker than has been found possible heretofore and with less shock to the switch operating parts. Bushing type current transformers are used and to conserve space are mounted in bushings on top of the oil circuit breaker compartment. Disconnecting switches are provided on both sides of all oil circuit breakers and are operated by means of a remote operated mechanism from the mechanism floor. The oil circuit breakers and disconnecting switches are mechanically interlocked.

An interesting feature of this station is the insulation of all high tension connections. All high tension busses, connections and runs from the generators and frequency changer are made of laminated flat copper bars, insulated for full voltage with varnished cambric tape, prepared in the shop in lengths of approximately 10 ft. and mounted on 25,000-v. porcelain insulators. These sections are bolted together and the joint covered with a thin copper form to cover the bolt heads and hand wrapped with varnished cambric tape to provide the same insulation as is used on the other parts of the busses and connections. For additional safeguard and to prevent the exposure of the busses and main connections to damage from external causes, these busses and connections are housed in concrete troughs covered with removable doors made of ¾-in. transite.

### Differential Generator Protection

The system of relay protection used provides for differential protection on the generators and transformers, balanced current protection between generator windings, overload and ground protection on the feeders and main bus ground protection on each bus section. The bus ground protection system is arranged in such a way that all insulators used for supporting the main busses with its connections and the insulators of all selector oil circuit breakers and disconnecting switches are connected to a separate grounding bus, so that a failure in an insulator will cause current to flow to this bus. The current is then carried through current transformers to the main station ground. Relays are arranged to op-

erate from these current transformers to cut out the generator, bus tie and station tie feeders which are connected to the grounded section, in this way cutting the affected section out of service, but not interfering with the remaining bus sections.

### Power for Driving A.C. Auxiliaries Obtained from 11,000-v. Busses

Although the main auxiliaries, such as the circulating water pumps, boiler feed pumps and the forced and induced draft fans are steam driven, auxiliary power to the extent of 8000 kv.a., at 2300 and 440 v., 25 cycles, is required in the initial installation and it is estimated that this will be increased to 20,000 kv.a. for the completed station. The power required for the auxiliaries is obtained from the 11,000-v. busses through step-down transformers with double secondary windings supplying the 2300-v. and 440-v. busses. Three transformers of 4000 kv.a. capacity each are installed at the present time, one of which is a spare. The transformers are fed from different sections of the main bus to insure an adequate supply in case one of the main bus sections should be out of service.

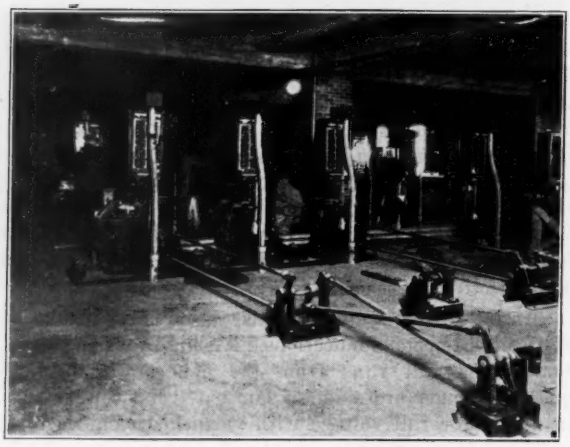


FIG. 2. OPERATING MECHANISM FOR THE OIL CIRCUIT BREAKERS AND DISCONNECTING SWITCHES

The busses on the 2300-v. system are sectionalized, with one transformer feeding each section. Bus tie switches are provided, making it possible to tie through from one section to another in case the transformer that feeds that section is out of service. The general scheme of connections used on the 2300-v. system is the same as is used on the Edison high tension system; that is, two feeders in a group supplied from either bus through selector oil circuit breakers. For large motors and main feeds, such as the coal tower and mill house supply, individual feeders are provided. In other cases a feeder supplies a group bus, supplying four small motors or transformers. All motors are designed for full voltage starting, thereby eliminating the complicated equipment required for automatic starting with a starting bus or compensator, and operated by means of push-buttons. The motor switches are located on the first floor of the electrical galleries and are operated by means of push-button control stations located at each motor. Continuity of service on the auxiliary system is assured, due to the fact that duplicate or spare feeds are provided for all important operations.

All auxiliary motors of 50 hp. or over are operated at 2300 v. All a.c. motors smaller than 50 hp. are supplied from the 440-v., 25-cycle system. This system is supplied from a third winding on the 4000-kv.a. auxiliary transformers and each transformer is designed to supply 800 kv.a. at 440 v. The 440-v. bus is sectionalized, with one transformer feeding each section and with bus tie switches arranged to tie the sections together. The main feeds to and from the 440-v. busses are controlled through remote control oil circuit breakers, operated from the auxiliary control switchboard. Feeders are run from the main bus to distribution busses supplying the different sections of the station. There are two 440-v. distribution busses in the electrical galleries—one in the service building and two in the boiler house supplying the boiler house and turbine room. The 440-v. distribution switchboards are of the safety type, fully enclosed, with hand operated oil circuit breakers on all distribution feeders.

The oil circuit breakers used on the 2300-v. system are of the truck type, the feeder, selector, transformer and bus tie switches having an interrupting capacity of over 100,000 kv.a.

### Coal Feeder Motors and Station Lighting from D.C. Generators

The station lighting, the boiler coal feeder motors and valve control motors are operated by direct current at 250 v. This system is supplied by two 500-kw. turbo-generators for the initial installation, with provision for the addition of two more turbo-generators of the same size for the completed station. A 2240 amp.-hr. storage battery is connected to this system to provide an emergency source of power in case of failure in the supply from the generators, with provision for the installation of a second battery of the same capacity in the future. Duplicate busses are provided, and all circuits are controlled through carbon circuit breakers to either bus. The boiler coal feed motors, of which there are ten to a boiler, are supplied from a group bus connected through selector carbon circuit breakers to the main d.c. power busses. The main d.c. busses are located in the basement of the boiler house and the boiler coal feeder group busses near the boilers which they control. Each boiler coal feeder motor is controlled by means of a safety type switch and a starting box. The ten motors for a boiler are arranged for automatic group speed control which will raise or lower the speed of all motors feeding a boiler simultaneously, in accordance with the amount of steam required from that particular boiler.

## Calculating Receiver Pressure for Compound Engines

IN THE second paragraph of the article appearing in the November 1 issue, the low pressure cylinder size should be 54¼ in. instead of 52¼ in., and the last paragraph should be changed to read: "The ratio of power will be the ratio of 80.3 × 54¼ squared to 18.6 × 52¼ squared. Working out this ratio, we find that it is 0.932." The second paragraph on page 1174 should read, "In this case it works out that the m.e.p. = $\frac{165}{3} \times (1 + 1.0986) = 115.5$."

# Steam Purifiers Effect Saving in Texas Plant

STEAM RATE OF TURBINES INCREASES FROM 20 TO 40 LB. DUE TO SOLIDS IN THE STEAM. BY M. R. WOOD*

WHEN THE STEAM rate of a turbine apparently jumps from a normal 20 lb. per kw-hr. to 40 lb. per kw-hr., the engineer in charge may well suspect trouble in his meter. In the plant of the Imperial Sugar Refining Co., at Sugar Land, Texas, a condition of this kind occurred, but instead of finding the meters in error, the trouble was found to be in the turbine itself. The cause was dirty steam. The turbine passages were both eroded and blocked up with solids to such an extent that the steam rate was doubled.

At this plant, two 256-hp., oil-fired B. & W. boilers, Stirling type, generate steam at 225 lb. pressure and 100 deg. superheat. The steam is used to drive two

FIG. 1. A VIEW OF THE PLANT OF THE IMPERIAL SUGAR REFINING CO. AT SUGAR LAND, TEXAS

500-kw. steam turbines, operating condensing and direct connected to generator. One turbine is sufficient to carry the average load of 400 kw. the year around. The plant has operated for the past 5½ yr. with power off for not more than 5 min. during that entire period.

Boiler feed water is taken from a nearby creek and treated by a cold water system of chemical purification. In extremely dry weather this water has about 16 grains of hardness and very little suspended solids. In wet weather the hardness drops to three or four grains per gallon, but with a considerable mud and silt content.

About two years ago it was noted that the turbine steam consumption seemed to be increasing. The weather was dry and it was necessary to treat the feed water heavily. For a time the steam rate of the turbine increased only a fraction of a pound each day, but after a short time it jumped nearly a pound each day. Investigating the matter, a check was made of the flow meters and Bailey meters, but these were all found to be accurate.

Finally one of the turbines was opened and it was discovered that the nozzles had been partially eroded away, the impulse blade choked solidly with a fine, hard deposit, and the first rows of the reaction blades almost choked. After putting in new nozzles and thoroughly cleaning the turbine, the steam rate went back to the normal of 20 lb. again. Before cleaning, it had been 40 lb.

The steam had been carrying solid matter over into the turbine. Because of the high velocity of the steam through the superheater tubes, 8000 to 9000 ft. per min., none of this material had been deposited in the super-

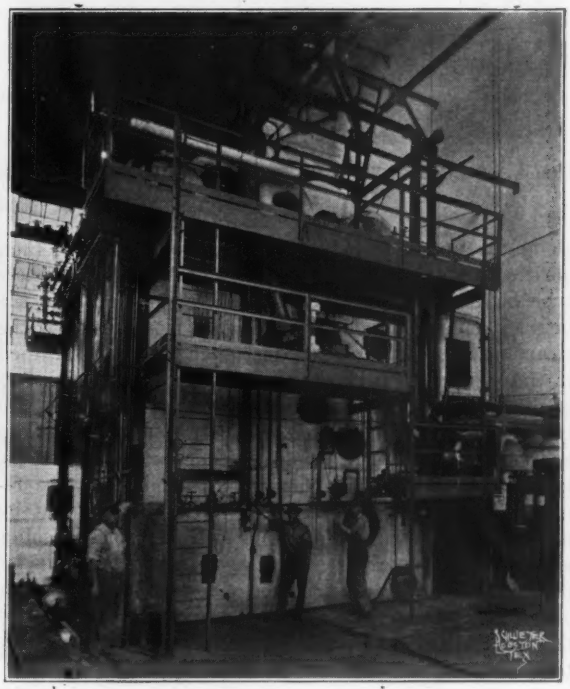


FIG. 2. THE TWO 256-HP., OIL-FIRED BOILERS ON WHICH THE STEAM PURIFIERS WERE INSTALLED

heater, nor had it appreciably worn the superheater tubes but had collected in the turbine.

After considering the matter thoroughly, it was decided to install a steam purifier and in May, 1924, two Tracyfiers were purchased and installed. Since that time there have been periods of dry weather, much more severe than that which caused trouble before, but there have been no further deposits in the turbine.

The purchase of these purifiers proved a good investment, since they have been responsible in no small measure for the "no-shutdown" record.

All boilers operate at from 125 to 175 per cent of normal rating most of the time. The water previously going over with the steam to the superheaters contained a high concentration of salt during dry weather. This water evaporated in the superheaters, but the dry salt was carried on to the turbine. The steam purifiers now deliver dry, clean steam to the superheaters, keep the water rate at normal, prevent choked steam lines and traps and make it unnecessary to clean turbines or put

*Consulting Engineer, Imperial Sugar Refining Co.

in new blades except as a matter of routine overhauling at very infrequent intervals.

### Action of the Tracyfiers

The action of the Tracyfiers may be understood from the accompanying illustrations, Fig. 3 and 4. These steam purifiers, as is well known, are installed inside the boiler immediately below and connected to the steam nozzle. As shown in Fig. 3, steam enters the device

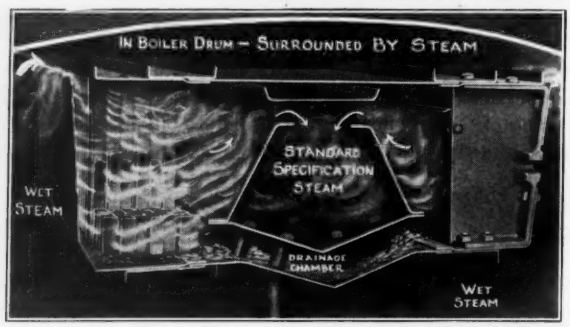



FIG. 3. PHANTOM VIEW OF THE TRACYFIER SHOWING ITS ACTION

along the upper outside edges, passes downward, then horizontally through the six rows of staggered gutter-type baffles, through the distributing slot and into the interior conduit through which it is conducted to the steam nozzle. Moisture or dust that may be entrained in the steam is scrubbed out by means of the six rows of baffles. Figure 4 shows how the impurities are trapped in the baffles. The moisture and impurities are conducted to a separate drainage chamber in the lower part of the Tracyfier, from which they are removed by a special drain line. It is claimed that by means of this purifier the steam is freed from all solids and that its dryness is such that throttling calorimeter tests will not show a variation of over 2/10 of one per cent from 100 per cent dryness based on the normal of the calorimeter. It produces what the manufacturers term "standard specification steam."

In determining the saving effected by the installation of these Tracyfiers, the cost of cleaning the turbines cannot be credited to this, because this work was

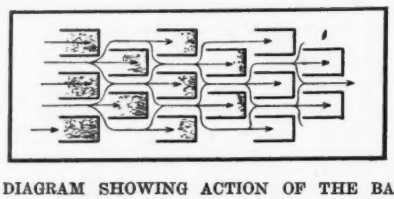


FIG. 4. DIAGRAM SHOWING ACTION OF THE BAFFLES IN REMOVING IMPURITIES

done by the regular engine and boiler room crew. Nor should the entire cost of reblading be included. This is now being done after 5½ yr. operation, 2 yr. with Tracyfiers and 3½ yr. without. Nor can the Tracyfier be credited with a reduction in turbine water rate from 40 to 20 lb., because operation under such a condition could not have continued for a time longer than required to find the trouble. The loss due to the increase in water rate is figured as follows:

Water rate of 500-kw. turbine after month of operation without purified steam.....40 lb.
Water rate after installation of steam purifiers—normal .....20 lb.
Increase in steam consumption.....20 lb.
Steam lost per month—400 kw. × 24 hours × 30 days × 20 lb. × 33c ÷ 1000.....$1,900.80

Without the purifiers, however, it would have been necessary to clean the turbine frequently during dry spells and, except just after each cleaning, operate with a steam consumption somewhat in excess of normal, due to progressive clogging.

# Keeping the Atmosphere Clean

WHEN AN industrial community realizes that keeping the air clean is a project of similar magnitude to keeping streets clean, providing clean water, removing city waste, or guarding the moral atmosphere, then there may be hope of success in smoke abatement, states O. P. Hood, chief mechanical engineer, Bureau of Mines. "We usually think of the project in too small terms. It is thought of as is the dog catcher or the boiler inspector—a matter of a man or two, a job or two, and a small appropriation of variable and uncertain amount, to be abolished in a fit of economy and reestablished under pressure of a vigorous minority.

"Even so, it is surprising how much is obtained for the effort; but the community is rarely satisfied, for the job is bigger than it was conceived to be; continuous, never-ceasing effort is required to clean up a smoky city. A few months of relaxation and some years of effort are canceled.

"It is useless to look for a spectacular cure. Success comes only after long-continued, highly skillful effort. When a new plant goes in and it proves to be a smoker, remedying the condition is difficult. The community will probably have to stand smoke for a long time while the owner spends money temporizing with weak expedients, finally arriving at the conclusion that 'it can not be done.' The remedy is to provide such engineering oversight of new installations as to insure a nonsmoking plant to begin with. This can be done. It may mean changes in building plans, a larger investment, a greater responsibility of management, a more intelligent operation, but these things are the price of clean air. The higher grade of installation usually pays well by reducing running expenses. It is of little use to complain of smoky stacks and allow new ones to be added daily. It is not often that smokelessness is one of the main objectives in an installation. Capacity, convenience, efficiency, and low cost come first, with a weak but laudable hope that smokelessness can be had also at no increase in cost. This order must be reversed in the public mind if we are to have clean air. Smokelessness must be a first requirement. These simple illustrations indicate that successful smoke abatement is a problem requiring high technical ability, the administration of a difficult human problem, a change in attitude of a community, willingness to wait for results, and readiness to pay for continuous, long-time effort free from political control. So far we have not found this combination, so that results are incomplete.

"There is a great waste of ineffective effort in smoke abatement agitation that gets nowhere because of a lack of vision as to the kind of job it is and an unwillingness to pay the price. Engineers believe that it can be done, and at a price not out of proportion to its worth."

# Engineering Offers Success to Non-College Men

HOME STUDY AND THE PROPER KIND OF BOOKS OFFER OPPORTUNITY TO THE MAN DESIRING SUCCESS IN ENGINEERING. BY JOHN S. CARPENTER

AFTER an experience of over 18 yr. on my own account and tutoring quite a few young men in this line, the writer contends that the various branches of engineering offer greater chances of success than ever before to the non-college man.

Too often, we hear from young men, worthy of better words, the wail, "I'll never get anywhere in this business; the college man gets all the good jobs and employers can't see a man's name unless it has a few initials behind it." So they often quit jobs that will eventually lead to better things.

A little dissecting thought reveals that the last mentioned state of affairs is merely apparent; that employers in general are ready and willing to recognize anybody who can show good performance because nobody yet, by looking over an applicant's cranial bumps and hollows, has discovered an infallible means of telling just what a given man will amount to. What is more, many employers are willing to do quite a lot of coaching and guiding for men of even reasonable promise to help them find themselves, in the interest of their own labor turnover.

Looking at the matter in cold blooded fashion, what is a college degree and what is it good for? Is it merely two or three initials stuck on to one's name in trailer fashion, is it an index to the possessor and does the possession of one or more college degrees guarantee success in life? A college degree is really nothing more or less than an evidence that the owner has pursued a regulated and definite course of study at a duly accredited institution of learning, usually under some form of state supervision. When found at the end of a man's name it means, with other things, a certain standard of cultivation and the public takes it at face value until there has been shown good and sufficient reason for not doing so. It is not an index to the possessor except in a very superficial way and the archaic titles such as "Master of Arts," "Bachelor of Science" are often misnomers.

There is no reason for doubting that if a self-educated man went through the same course of study, stripped of its non-essentials, under some form of recognized supervision, he would be just as good from an utilitarian point of view as the college man. In some respects, all other things being equal, the self-educated man might have the better of the argument because of the extra backbone and persistence gathered in the struggle.

A college education is not a thing to be discounted, however. If you can get one, by all means take it, even if you have to work every step of the way to keep going. But if the Fates are against you and it is clear that you cannot get the much-prized sheepskin, do not, I pray thee, sit in sackcloth and ashes and be forever discouraged. The will to be somebody and persistence in it alone will accomplish a great deal, but couple with that a definitely directed ideal and a mental picture of what you want, then you have superpowers and nothing can permanently block your progress to the thing called SUCCESS.

What is Success? What does it consist of? What do people mean when they say that so-and-so is successful, that his work and life are a success? When we use the word in this sense, we mean that the man has learned to do worthwhile things well and get paid for them accordingly. You wouldn't exactly call that a dictionary definition; however, that is what we mean without saying it.

Ask a hundred successful men to what they would attribute their success, be they engineers, lawyers and whatnot; you would receive a great many different answers which might seem to give a scattering idea of the matter. But simmer the whole down, eliminate, piece together and draw a general balance and see what you get. Let me suggest a possible classification; others might group the different elements variously:

(a) A moderate degree of what we call "brains."

(b) The desire to be, focused on a general mental picture and reinforced by a constant demand for realization (usually more or less subjective).

(c) The necessary health to do the work.

(d) The persistence to accomplish.

(e) The proper tools with which to accomplish.

Study that group and see if, finally, you do not formulate something very like it yourself. With the normal course of things, to state it as a formula, we might say that

$$\text{Success} = a + b + c + d + e$$

and you can see how necessary it is that all these quantities be available.

A moderate degree of brains includes the mental facilities of the great majority. As soon as real study starts and thinking follows study, we find a gradual mental improvement. Many brilliant minds will admit that at ordinary school they were not especially bright, showing that cultivation and use of the mental tools will do wonders.

I will leave the other quantities for the reader. He will see the necessity for them and render them in his own way. But let us talk about (e). The proper tools to accomplish, liberally interpreted, are the books we use to learn how to do the worthwhile things well. Many practical men detest books. Perhaps much of the dislike is due to the fact that there is a certain knack of getting the message that a book has to tell. One of the hardest ways I know of is to start in at the book from the beginning and work right on through it, not passing anything until one understands it.

One of my friends, who is a professional book reviewer, says: "When I get a new book I note the title and author's name and start turning over the pages rather rapidly, but noting chapter headings, interesting things here and there, drawings or pictures and so on to the end. Then I go over it a second time, take a closer look at it, finding that by the first casual going over I already have a fair mental picture of the book and its method. I now start to note passages here and there, note the viewpoints advanced, etc. After the second going over, I can start actual reading and then I have the book well in mind, can trace any cross-references much better and know what is coming. Many

times, seeing a strange looking formula, I will skip it if it seems dubious or hazy and usually I find there is a later explanation of the thing that was doubtful."

Familiarizing one's self with a book by several times going over the book in a casual way makes it much easier to get a better close-up of the subject. That much being true, or at least accepted on faith for the present, let us state the great climax of the book problem; get the right kind of books. Do not expect, unless you are fairly well advanced in the given subject, to get much out of handbooks. That is not the mission of a handbook. What is now needed is a text book, and not a book that compresses into small space data whose "reason to be" the reader is already supposed to know. Handbooks are fine for reference when you already know the laws upon which any subject is founded, to give tables of experimental data and other facts that pure theory does not directly disclose. When formulas are given, they are compressed and the explanations are very brief. Again, do not buy college men's books with the idea of absorbing the subject. You may do it by continually asking someone who has a good knowledge of the matter, but the chances are that you will not gain what you are after and besides you may become exceedingly unpopular for the rain of questions.

Get books that are written for those who study alone. They usually carry full and detailed explanations and show one or more examples illustrating the problem, worked out. You will do well to follow out the example and copy until you can stand on your own feet, so to say. These books are what are often contemptuously called correspondence school books. Often you can pick up a whole set covering just the subject you want, at a secondhand bookstore, at a nominal sum. Be sure that you get a late edition; for example, the late developments of combustion engineering, late developments in radiant heat and superheated steam, high-pressure boilers, etc., are not found in the older editions. Do not let any ambitious bookstore clerk sell you alluring titles with the word "easy" and the like in them. Years of experience have told many of us that the only "easy" thing about them is the buyer.

Do not make the stern rule that you will study every night; for you will soon be worked out and sick of it. Take a moderate course, study two nights and take the next one off; study the next two and rest the following night. Don't study more than three hours a night; you will not feel like getting up next morning. More haste makes less speed in this as in other things.

As soon as you begin to do much figuring, you will want to get a slide rule, which is a mathematical instrument used in making calculations rapidly. Getting familiar with it is essential and my advice is take the rule out with you, leave the instruction book home and go to a place where nobody can hear your rough language. Take the simplest of examples at first—they will be difficult enough.

By the time you have gotten well into your subject, you might take the boss into your confidence and tell him you are burning the midnight Mazda to good and useful purpose. If he is the type that responds favorably, you might keep him advised as to your progress; if not, work right along and some day you will enter more harmonious conditions. Keeping your ideal firmly in mind and knowing that so many others before you have attained worthwhile things and you can too, you will find things gradually opening up so you can make the change without undue shock.

After some practical experience in the new work, you may be called upon to decide between sales work and purely designing work. That is a matter you will have to weigh carefully and decide for yourself. Both have their attractions and while sales work seems to lead more in the direction of the business executive and many prefer that, you might be better fitted for purely technical positions.

Persistence develops a latent power of analysis that is valuable. In your studies, should you come upon a formula that you cannot establish for yourself, take it on trust for the while and try later to reason it out. Remember that all formulas are physical laws stated in terms of mathematics, and as for the empirical ones you will meet, well, they just happen to fit the results.

The upward path is not without its thorns and the acquirement of technical knowledge should go hand in hand with general cultivation of personal characteristics. People do judge largely on first sight, and no more unfortunate impression can be created by the aspirant than that of a tongue that wags profanely. Not that cussing is not very expressive and at times seems exactly to fit the needs; it can be entirely dispensed with very nicely, and the higher you rise the less you will find it among the better class of men.

If by following the ideas outlined above, you get somewhere worthwhile, help someone else get ahead and to better things. The birds you send out will always come home to roost.

## Great Western and San Joaquin Companies to Spend Large Sums in 1927

When the Great Western Power and San Joaquin Light and Power companies were placed under the control of the North American Co., and when the Brighton-Merced tie-in was planned connecting up the two systems, broad statements were made as to the ideal combination that had been effected. While the tie-in has been finished less than a year, the benefits accruing from the interconnection are ascertainable. James B. Black, vice president and general manager, who shortly leaves for New York to direct the activities of the local companies from the home office of North American Co., states that the two companies are closing the best year in their history.

The Great Western will show an increase in new business from 20 to 25 per cent, with those of the San Joaquin Light and Power Corp. approximately as much. The earnings of both companies, too, will show about similar increases in net over last year, with Great Western slightly higher.

Precipitation this year and water now in storage is very encouraging for the 1927 showing, inasmuch as watershed measurements on January 17 were 119 per cent of normal for San Joaquin and 134 per cent of normal for Great Western. This means that unless conditions change, plenty of water will be available for a maximum generation of hydro-electric power in 1927.

The two companies have a budget calling for the expenditure of $4,000,000 on the Balch project in 1927; $2,000,000 on Lake Almanor; and approximately $8,000,000 in miscellaneous distribution and substation work. This only takes care of new developments, not replacement or maintenance.

# Packing for Refrigerating Machines

DESCRIPTIONS OF REPRESENTATIVE TYPES AND DISCUSSION OF OPERATING CHARACTERISTICS OF MODERN PACKINGS. BY W. H. MOTZ*

AMONG THE MOST important things in the economical operation of an ice making or refrigerating plant are the selection, correct installation and the proper care of compressor piston rod or shaft packings. The operating engineer is required to adjust and keep the packing at a good working efficiency in order to reduce the leakage losses to a minimum. A large portion of the refrigerant losses in an ice making or refrigerating plant may be charged, properly, to the compressor stuffing-boxes. The plant owner is interested in this proposition because he must pay the bills for refrigerant so lost.

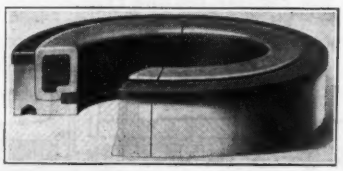


FIG. 1. COLLAPSIBLE TUBE METALLIC PACKING

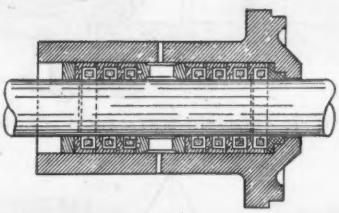


FIG. 2. APPLICATION OF COLLAPSIBLE TUBE METALLIC PACKING

FIG. 3. FLEXIBLE METALLIC PACKING

Requirements of a good packing may be summarized as follows: (1) it must reduce the leakage to a minimum; (2) frictional resistance must be reduced to a minimum; (3) it must be resilient to compensate for changes of conditions; (4) it should have a fairly long useful life. Detailed descriptions of some of the representative types of packing are given in the following paragraphs.

*Technical Engineer, Hill Mfg. Co., Chicago.

## COLLAPSIBLE METALLIC TUBE PACKING

Figure 1 illustrates a form of non-elastic metallic packing, which may be termed a collapsible tube type. The application of pressure by the gland slightly collapses the tubes in the direction of the length of the rod, which compensates for wear and holds the face of the tube against the rod. The packing is made up of a series of hollow babbit rings filled with graphite. The babbit rings are supported by cast-iron cages which clear the rod. Both the ring and the cage are split and the joints are sealed by the use of proper gaskets. These gaskets also provide for a slight amount of resiliency. The graphite flows from the babbit rings through the emission holes due to the action of the rod, keeping the rod and packing glazed over with a thin layer of graphite at all times. A series of these cast-iron and babbit rings are placed in each compartment of the stuffing-box.

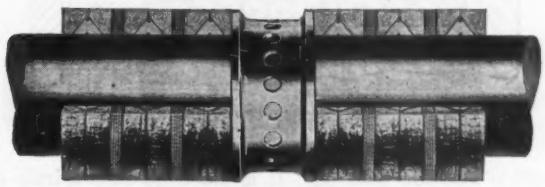


FIG. 4. FLEXIBLE METALLIC PACKING WITH SOLID BABBIT RINGS

FIG. 5. FLEXIBLE METALLIC PACKING WITH RESILIENT PACKING

Figure 2 shows the application of collapsible tube packing for high, medium and slow speed reciprocating rods.

Collapsible tube type packing, as illustrated in Figs. 1 and 2, meets the requirements of a good packing in an efficient manner. In actual operation it reduces the leakage to a minimum. Since only babbit metal touches the rod, the work required to reciprocate the rod to and fro in the box is low. It is self-adjusting within reasonable limits of change of conditions. It is quite durable in service, the useful life of the packing being from 2 to 10 yr. or more, depending upon the local conditions. The useful life of the packing depends upon a number of variables, of course. Being rigid in construction, the packing requires delicate adjustment of the gland to secure the proper pressure upon the rings. Also, as the lower crosshead slide and the bottom of the cylinder

become worn down, the center line of the piston rod is lowered, concentrating the weight of the parts upon the packing. Under this condition the metallic rings tend to wear to an elliptical form, which makes leakage probable. This type of packing may be used with good results on all types of machines, horizontal double acting, vertical single acting, enclosed, etc. When used on aqua-ammonia pumps, the graphite prevents the rods from pitting and corroding.

Another form of non-elastic metallic packing is illustrated by Fig. 3. This type is commonly termed

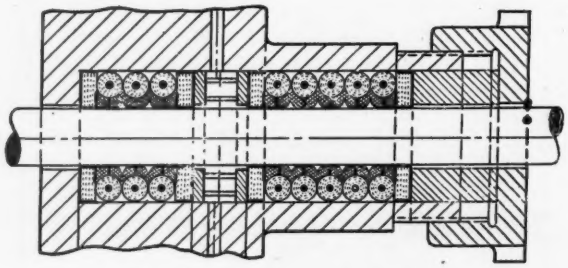


FIG. 6. COMBINATION PACKING

flexible metallic packing. It is made up into spirals of continuous convolutions of babbit ribbon passed through a bath of lubricant. Rings of this metallic packing are cut off and assembled with fabric wiper rings on the rods.

Figure 4 illustrates another form of this same general type of packing. The V-shaped solid babbit rings are backed up with the flexible metallic rings. Fabric wiper rings are also inserted. Still another form of this packing is illustrated by Fig. 5. This consists of a continuous babbit ribbon wound spirally for the central insert and a resilient fabric support on backing. Rings of this type of packing are cut off at the proper length and inserted directly into the stuffing-box.

Flexible metallic packings, shown by Figs. 3, 4 and 5, are efficient packings. The packing reduces leakage of the medium under pressure to a minimum, due to the fact that babbit rings are held firmly against the rod by the pressure exerted by the gland. The packing is compressible, therefore it permits lateral movement. Amalgamation under pressure is prevented, since there is a thoroughly broken metallic surface between each convolution of the babbit ribbons. The friction loss is small, since a large portion of the packing against the rod is composed of anti-friction metal, therefore the rods run cool. The packing adjusts itself automatically to compensate for expansion and contraction due to temperature changes. No gland adjustment is necessary, excepting a slight take-up to compensate for wear. Additional rings must be inserted at certain periods to make up for the wear of the rod on the packing. On the whole, the packing is durable and sets will last for years. The life of the packing is affected by the physical conditions of the rod. It gives the best service on rods that are true and in line. Supplied in the form of handy, flexible spirals, it is easily installed. This type is recommended for service on the rods of any compressor having a speed of 400 ft. per min. or less. It is used successfully on rotating shafts. The fabric wiper rings break up any film of liquid that may cling to the rod, therefore the packing may be used on pumps handling liquids.

A great portion of all packing in any plant is used on the hand valve stems. Flexible metallic packing may be successfully used for this service. Rings are cut from the handy spirals and are placed in the boxes around the stems, breaking the joints. This packing prevents leakage, permits the stems to rotate freely, and protects them from scoring, rusting or pitting.

Flexible metallic packing combined with solid V-shaped babbit rings, as shown by Fig. 4, may be used on any compressor rod having a speed from 400 to 1000 ft. per min. The solid babbit rings prolong the life of the packing. Otherwise it has the same general advantages as the regular flexible type.

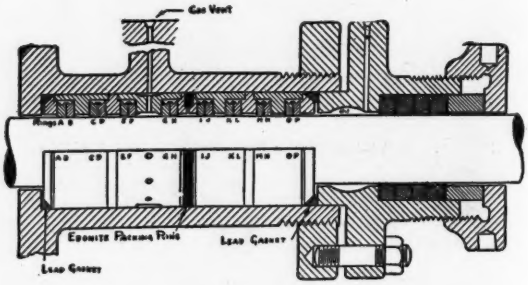



FIG. 7. ELASTIC METALLIC PACKING

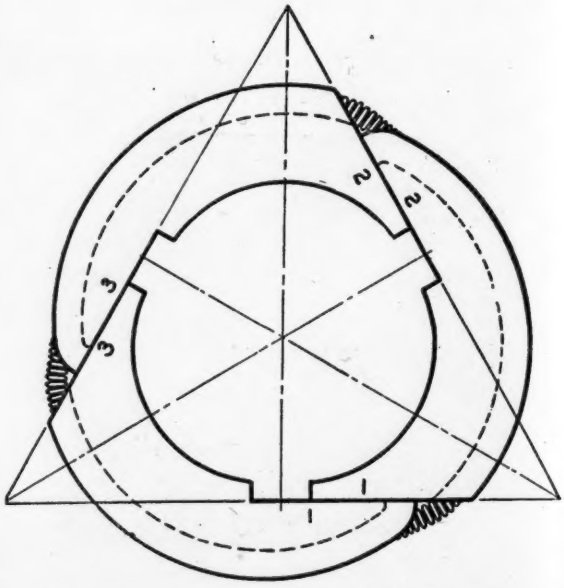



FIG. 8. RING OF ELASTIC METALLIC PACKING EXTENDED TO SHOW PARALLEL MOVEMENT OF JOINTS

Flexible metallic packing with a fabric backing, as shown in Fig. 5, has been produced to supply the demand for a flexible metallic packing to be used on rods that are slightly out of true and out of line. The resilient backing compensates for the irregular physical condition of the rods. This type should not be used on rotating shafts on account of the fact that scoring might be produced by the action of the fabric backing upon the rod. It produces a gas-tight joint on the surface of the rod. Due to the insertion of the fabric backing,

the friction loss in increased slightly. On the other hand, it is automatic in adjustment to change of conditions. It is made of durable materials.

### Combination Packing

Figure 6 shows another form of packing which is a combination of metallic and fibrous types. The babbit rings are held against the surface of the rod by the fabric rings when pressure is applied by means of the gland. The primary rings are supported by the metal backing rings. Suitable gaskets are inserted for sealing the joints in the rings.

Combination packings illustrated by Figure 6 have been produced in order to supply a packing that would combine the advantages of both the fibrous and metallic packings in a single packing. They depend upon the action of the metallic oil seal to prevent leakage rather than the pressure of the packing against the rod.

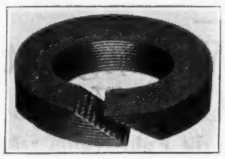


FIG. 9. RUBBER AND DUCK PACKING

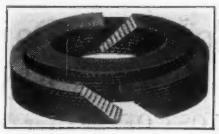


FIG. 10. SECTIONAL RINGS OF RUBBER AND DUCK PACKING

FIG. 12. FIBROUS PACKING, "Z" RING TYPE

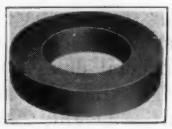


FIG. 13. ALL RUBBER PACKING RING

Friction losses are low since the rubbing surfaces are composed of anti-friction metals. They are automatic in adjustment to physical conditions, on account of the resiliency of the fabric portion of the rings. Since they are constructed of durable materials and have solid metal rings against the rods, the wear on the packings is slow. The packings may be used on all types of compressors. They may be used on rods that are untrue and slightly out of line.

### Elastic Metallic Packing

Elastic metallic type of packing is illustrated by Figs. 7 and 8. The metallic rings are held against the surface of the rod by helical springs around their circumferences. The rings are made into three segments as shown by Fig. 8 and make tight joints on the rod and against the partitions of the casings. The rings and casing are usually made of cast-iron. The rings and casing are machined and fitted to the individual boxes and rods. Fibrous wiper rings are inserted in the gland to retain the lubricating oil.

Metallic packing of the elastic type as illustrated by Figs. 7 and 8 has been used extensively in certain fields with apparent success. The oil film between the cast-iron rings and the rod prevents the escape of the high pressure gas. The friction of the special cast-iron rings on the rod is quite low. In fact, it is claimed that this type of packing requires but one-quarter of the amount of power to overcome friction that the fibrous or soft packings demand. The packing gives the better service on the longer rods. The packing has no means of adjustment after installation. Each set is machined and fitted for the particular rod on which it is used, therefore it is limited to exclusive use on the original rod. However, it operates efficiently under changing conditions. It has a very long life, from 5 to 25 yr.

This type of packing has been used extensively in the past on high duty apparatus. It may be used on the rods of all types of compressors. The rods should be true and in line for the most efficient operation, but it will function properly on rods that are slightly out of line, since the rings may float in the compartment of the casing. On the other hand, it is not suitable for all vapor and liquid conditions that may occur in the refrigeration plant. It gives best service on compressors which handle vapors that are only slightly superheated. This condition may be obtained oftentimes by the proper adjustment of the liquid expansion valves. It should be well supplied with lubricating oil at all times. The first cost is comparatively high, on account of the accurate machine work that is required in the fabrication of the sets. It has been used on the largest steam, air, gas and ammonia plants, under all conditions of pressure and temperature.

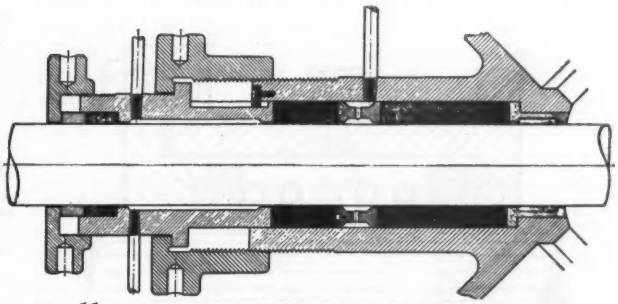


FIG. 11. APPLICATION OF SECTIONAL FIBROUS RING PACKING

### Fibrous or Soft Packing

Fibrous packings are generally composed of a combination of rubber and a fabric or cloth made of cotton, flax or asbestos. These are mildly vulcanized and thoroughly lubricated and are made up into several forms, such as round, rectangular, or wedge shaped, with rubber cores and backs, and with laminations being horizontal, vertical or diagonal. The function desired is that the packing will move toward the face of the rod when pressure is applied by the gland.

Figure 9 illustrates one type of fibrous packing, composed of a special grade of rubber and duck and is thoroughly lubricated. The laminations are vertical. Figure 10 shows this type cut up into a sectional ring. The application of this type of packing to a compressor stuffing box is indicated in Fig. 11. The sectional rings are interposed between the plain rings at the ends of each packing compartment.

Another type of fibrous packing is indicated by Fig. 12. This is composed of duck and rubber laid up in diagonal laminations and is thoroughly lubricated.

Another form of packing may be made by using the

regular packing rings, as shown in Fig. 9, and sectional rings as illustrated by Fig. 10, and by alternating the two types as they are placed into the box. Still another method of using fibrous packing may be obtained by inserting the plain regular rings, Fig. 9, the pure rubber rings, Fig. 13, and the sectional rings, Fig. 10, into the stuffing box.

The relative position of the gas lantern should be noted. The desirable arrangement is that a greater number of rings should be placed between the gas lantern and the region of high pressure.

Ordinarily these types of packing are not sensitive to the change of temperature. Thus, when the machine becomes cool, it may be necessary for the operator to tighten up the packing gland to prevent leakage, or, if the machine is allowed to become hot, it is necessary to loosen the gland in order to prevent harm to the packing due to the excessive heating effect of the frictional work. In consideration of these facts it will be noted that the life of the packing depends upon the care that is bestowed upon it. The fibrous type of packing has been used extensively on all types of compressors and pumps. It has been used on rotating shafts, but a decided grooving action may develop if the packing is not properly regulated. The fibrous or soft packings are being replaced by the metallic and combination types, due to considerations of friction and durability.

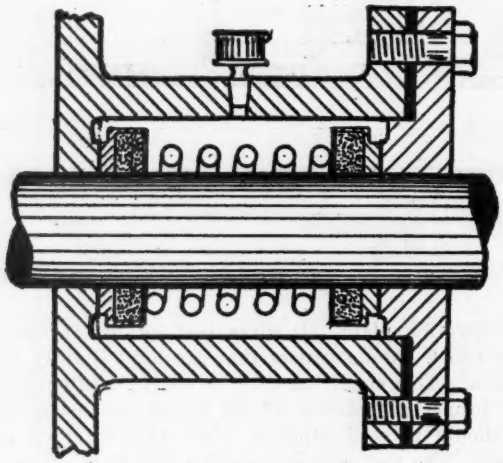


FIG. 14. SEAL RING PACKING

Soft or fibrous packings that are illustrated by Figs. 9, 10, 12 and 13 perform their functions well, provided they are under the care of a careful operating engineer. They prevent the leakage of other medium under pressure by being forced against the surface of the rod by the gland, since they have lateral movement due to being comprised of resilient materials. On account of being composed of materials that are more or less frictional in character and because of the forcing of the packing against the rod, the power required to overcome the frictional effect becomes excessive if the packing is not given the proper attention. The soft rings contain lubricants but, under operating conditions, a liberal use of oil is necessary. Sometimes thin lead washers that clear the rod are inserted between the fibrous rings to facilitate lubrication. The excessive friction effect necessarily causes the scoring, wearing and shouldering of the rods. Bits of packing may find their way into the cylinder.

### Seal Ring Packing

A new type of packing which is adaptable to rotating shafts is illustrated in Fig. 14. This packing consists essentially of ground joints, seal rings, rubber rings and a compression spring. The action of the spring is to hold the seal rings against the ground seats, and to compress the rubber rings against the seal rings proper and the shaft. Consequently, the seal rings, spring and rubber rings rotate with the shaft. The packing may be lubricated with either oil or grease. It is used on shafts of machines handling either liquids or gases.

This seal ring type of packing operates with a minimum amount of friction. The friction consists only of the resistance of the seal rings, running on a ground seat. It is inexpensive and is claimed to last considerable length of time and to require very little attention or adjustment, outside of lubrication.

## Sorpetal Dam Will Regulate Water Flow Over Years

MOST OF the river dams in the Fuhr region regulate the water supply over months and seasons only. To secure the greatest benefits from the water falling during a heavy rain year, for the drier years, a larger storage space is essential. For this reason the Germans are building the Sorpetal dam which allows for a water storage space of 2,860,514,000 cu. ft.

Among the dams at the present planned in Europe, the Sorpetal dam is unique. It will be built of earth. Its height from the valley floor to the top will be 194 ft.; the entire height, 226 ft. On the crest its length will be 2165 ft., while the width of the sole will be 1009 ft., and the width of the crest 33 ft. About 106,000,000 cu. ft. of earth will have to be moved.

The water side of the dam is to be made water-tight by using loam from the valley bottoms and eroded shale from the hillsides. The earth is packed with rollers and the slope surface reinforced with concrete plaster.

Through the center of the dam is a concrete core cutting deep into the rock bottom and reaching to the crest. On the water side this core is provided with several coats of water-tight protective. Should any water pass through the surface, it will be carried away through canals located in the core. An easily accessible, concrete enclosed runway is provided thereto, the entire length of the dam, so that the water-tightness of the dam is easily determined by inspection. The other side of the dam requires enormous amounts of earth to support the pressure of the water against the dam. The water can run off through two galleries, one of which leads it to a power plant.—Translated from VDI-Nachrichten, by John H. D. Blanke.

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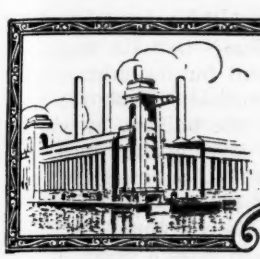
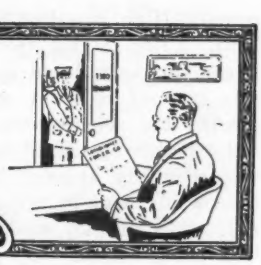
Eastern Texas Electric Co. of Delaware, a subsidiary of Engineers Public Service Co., has purchased the Nebraska Electric Power Co., which serves 25 towns in central and northwestern Nebraska. The Nebraska Elec. & Power Co. will be under the executive management of Stone & Webster, Inc., and will be operated from Scottsbluff, Nebr.

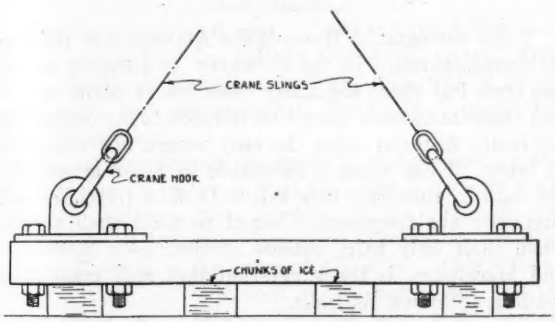


# LETTERS DIRECT FROM THE PLANT



## Use of Ice for Lowering Heavy Parts to Position

IN THE SHOP where the writer supervised a large machine erecting job, we had a large casting of the shape shown in the accompanying sketch, which was handled by three chain slings from the crane. Bolts through the flange of this casting were used for attaching the crane sling hooks. When lowered down to the bed plate, it




BLOCKS OF ICE SUPPORT HEAVY PART, PERMITTING BOLTS TO BE REMOVED BEFORE PART SETTLES INTO POSITION

was impossible to remove the bolts from under the flanges; the weight of the casting, amounting to over 10 t., prevented the usual use of crow bars.

The method which was adopted for lowering these castings was simple, inexpensive and adaptable to many similar uses. Small cubes of ice were placed at equal spaces around the castings. The work was supported by these ice blocks permitting the removal of the bolts. After this the temperature of the steel rapidly melted the ice away and the job gradually settled down in position.

Washington, D. C. GEORGE A. LUERS.

## Welding and the Welding Rod

MANY PERSONS have the idea that the "personal equation is the difficult problem in welding." "Everything depends on the welder," they say, and then proceed to ask, "How can I be sure he is a good workman?"

Important though this matter is, it must be emphasized that the workman is only one factor in the correct procedure control. True, you must have good welders (and they are obtainable and teachable and reliable), but they must also have good materials to work with. It is of the utmost importance to standardize on materials of high and unvarying quality.

Best blowpipes and highest grade of welding rods and fluxes will so facilitate welding that their use will soon be repaid many times over. Since one of the most important of these items is the rod, the largest manufacturers of welding equipment and supplies are devoting great attention to developing new and improved welding rods.

One of the simpler tests which is commonly used can readily be made by any operator, in order to determine the excellence of his present supply. Place a rod on a welding table so one end extends well over the edge. Then melt it with a blowpipe, watching for impurities or cavities. A good rod will melt easily and quietly with practically no sparkling. Another good test can be made by laying the rod on a metal slab and then remelting it repeatedly. The first time the blowpipe has been moved slowly along, there should be no excessive sparkling, and no pin holes should remain in the melted metal. A second or third application will show proportionately more sparkling and a larger number of pin holes. But if there is a great increase each time the rod is not of very high quality.

A good rod, one which can withstand such tests, gives a good weld because it has no impurities to be left in the weld metal and no gas pockets to prevent steady and smooth flow.

In actual work the operator can recognize good welding rod with no trouble at all. The rod should flow easily without excessive sparkling; it should be easy to control even in overhead welding, and should be capable of being worked rapidly. For most work another prime consideration is strength; a good welding rod should give a weld which, when properly made, is stronger than the best quality of flange steel or boiler plate.

One of the first types of rod used extensively for oxy-acetylene welding was of almost pure iron from Norway and Sweden. When the supply of this material was cut off during the early years of the World War, the low carbon steel or so called "drawn iron" rods replaced them. "Norway iron" has therefore lost its precise meaning; most of the welding rod called Norway iron is merely a low carbon steel made in the United States especially for its welding properties. The weld metal resulting from its use is practically pure iron, and contains only 0.02 to 0.03 per cent of carbon; consequently, joints made with this rod, while tough and ductile, are no stronger than the softest staybolt iron.

An important factor which must be anticipated in the development of new welding rods is the change in chemical composition which takes place when they are melted by the blowpipe flame, therefore, they must be of such composition that the metal in the weld will be of high quality, sound and strong.

An important development in welding rods is the

recent "High Test Rod" put on the general market in 1925. Prior to this, from 1923 to 1925, operators employed in the railroad shops all over the country used this type of rod. It was their success with it that created the general demand. Welds made with this rod, whether by second rate or by the best of operators, will regularly average 11,000 lb. per sq. in. stronger than welds made by the same man with low carbon steel rod. It is an alloy steel, its essential chemical composition being carbon, 0.20 per cent; manganese, 0.80 per cent; silicon, 0.55 per cent. The weld metal retains nearly all the carbon. The manganese and silicon lost in melting act as a self-flux. Hence the strength and soundness of joints made with it.

Every welding operator, and every manager who directs welding operations, will find that quality and correct composition in welding rods is a matter of utmost importance. Given good rods, a good welder can be sure of the highest possible strength and quality in his welds; and even a welder of indifferent ability can improve results by wise selection of such material.

New York, N. Y. E. H. SHARP.

## Home Made Articles at Times Serve Well

YOUR EDITORIAL entitled "Home Made Articles Are Inferior to Manufactured" was read with interest. Much can be said on both sides of the question. An engineer who is without the resourcefulness and inventive talent to devise methods and apparatus to meet the problems that he faces every day would not, I am afraid, rank very high in his calling.

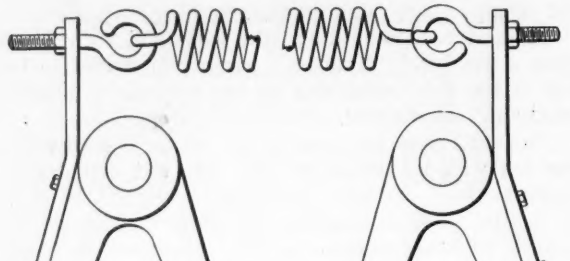


FIG. 1. HELICAL SPRINGS SERVE BETTER THAN MANUFACTURER'S FLAT SPRINGS AND COST MUCH LESS

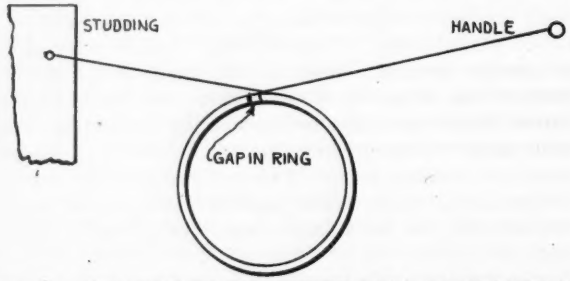



FIG. 2. ONE TURN OF WIRE SERVES WELL IN COLLAPSING PISTON RING WHILE ENTERING PISTON INTO CYLINDER

Figure 1 illustrates a part of the valve gear of a small Corliss engine. This indicates that the engineer has been giving play to his talent for invention. The reasons for doing this were two-fold. First, the flat U-shaped springs furnished by the builder, by either breaking or weakening, were a never ending source of trouble. The other reason was that the manufacturer charged the exorbitant price of $7.20 apiece for them. The change in construction indicated would not look well on a new engine, but as used gives a smoother action, causes no trouble and costs little.

Sometimes when replacing a piston in a cylinder it is hard to get the rings to enter the cylinder. A simple way to do this is to take a turn of about number 14 wire around the ring, handles having been fastened to the ends of the wire as illustrated in Fig. 2.

Two men pulling on the wire can collapse almost any size ring. If short-handed, one end of the wire may be fastened to a stud as illustrated.

Anderson, Ind. J. O. BENEFIEL.

YOUR EDITORIAL, "Home-Made Articles Are Inferior to Manufactured," in the February 15 issue, is doubtless true, but there are many cases where plant owners and superintendents cannot be induced to lay out money for costly material when the only return is a reduction in labor. Even when a reduction in labor is possible, the man in authority may fail to O. K. a purchase, and engineers are frequently obliged to make such articles when their only help, outside of their own experience and knowledge, is the suggestion that may come from reading technical journals.

In one case the writer asked for a foot valve and strainer for a 5-in. pump. When the manager learned that we could get along without it, although its lack repeatedly meant extra work, he just forgot to order it and it was not bought. In this case, the writer made up a trap from scrapped parts. This proved so satisfactory that its description was published in a technical journal. About a year later a large manufacturing concern carried full page copy in various mechanical magazines advertising practically the same design of strainer.

While it is doubtless much better to purchase manufactured articles, it often amounts to simply this: Either one must make the article or do without it. Many times an engineer is justified in trying to help himself by making a home-made device, even if it also means helping an employer who refuses to help himself.

Toronto, Canada JAMES E. NOBLE.

## Don't Pull the Bolts Too Tight

WHEN using a wrench to tighten the nut on a bolt, never add a length of pipe or other handle extension to provide additional leverage. If added leverage were a good thing or excessive strain on the nut desirable, the wrench manufacturers would have designed their tools differently.

It is a mistake to believe that the harder a nut or screw is pulled up the better it will hold. To pull or twist a nut too hard will either place undue shearing strain on the threads (which will in time relieve itself either by cracking or permanent distortion) or the body of the bolt will be elongated and thereby reduced in

sectional area. The latter condition, if unrelieved, will result in deformation and ultimate weakening of the metal.

A screw or bolt is subjected to a certain strain as long as it is in use and while there may be no visible sign of weakness, this strain will fatigue the metal and eventually reduce its strength to a point where it will be dangerously incapable of sustaining the weight or enduring the shock of machine operation. The proper tightening of bolts, nuts and screws will add much to the service of the part.

To determine the degree of proper tension look to both the wrench and bolt. If the bolt will not hold the part securely by ordinary tightening, either an additional bolt is required for the part or the whole has been improperly designed.

Chicago, Ill. WILLIAM SIBLEY.

## Refrigeration Without Ice or Machinery

HERE IS SOMETHING NEW. I am informed that it is quite possible that ice will be eliminated one of these days. Small refrigeration machines, also, will be found unnecessary and uneconomical. Ice made of water will be a back number.

Solid carbon dioxide has made its appearance on the refrigerating horizon, and it is said that it does its work very well. Carbon dioxide freezes at the extremely low temperature of 109 deg. below zero Fahrenheit, which is 141 deg. lower than the temperature of ice. How's that?

Isn't it logical, now, that if ice cream, fish, butter, cheese, meat, etc., are surrounded with solid carbon dioxide at 109 deg. F., they will keep colder and better than if surrounded with ice at a temperature 141 deg. higher?

Everybody knows that liquid carbon dioxide is an excellent refrigerant, but the trouble with it in the liquid state is the great weight and inconvenience of its metal container. But it has been found that by solidifying the carbon dioxide the heavy container becomes unnecessary.

So now, with this new method, instead of packing a railroad refrigerator car with ice it is packed in solid carbon dioxide which produces a "dry" cold. There is no water to mess up the car or soak into the boxes or wrappings in the car. It is much lighter. The gas itself, as it evaporates, has an insulating effect. Lower temperatures will, of course, be maintained. Carbon dioxide gas is also a preservative for foodstuffs, which is an important advantage.

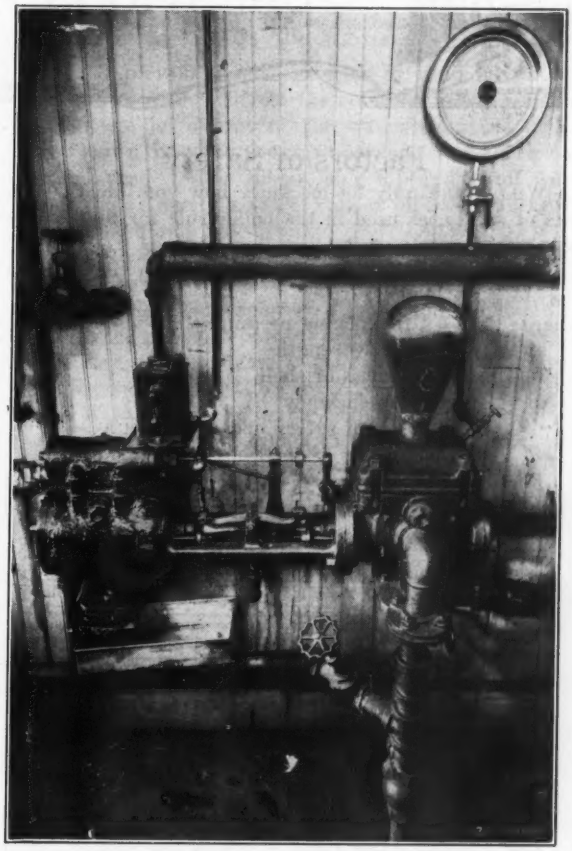
It is said that solid carbon dioxide will be of very great value on board ship as it will eliminate the necessity of the heavy and expensive machinery heretofore necessary for the production of cold. The ship will simply be provided with this new cold refrigerant at each port. It is especially valuable for the shipment of frozen cargoes at very low temperature.

Who can tell but that some day we shall have solid carbon dioxide delivered to our homes instead of ice? The objections to ordinary ice are that it is wet and it doesn't maintain temperatures that are sufficiently low. Ice isn't always sanitary. Solid carbon dioxide is dry, is sanitary, is very cold, and it is a preservative.

Newark, N. J. W. F. SCHAPHORST.

## Pump in Active Service 50 Years

IN 1876 THE Worthington (Knowles) simplex boiler feed pump shown in the illustration was installed in the Marshalltown, Iowa, waterworks. It was used day and night on boiler feed service until 1922. For the first 44 yr. it was the only boiler feed pump in the plant, a spare unit not being purchased until 1920. In 1922 the old pump was placed on light pressure service, but used on boiler feed service from time to time while the new pump was being overhauled or repacked.

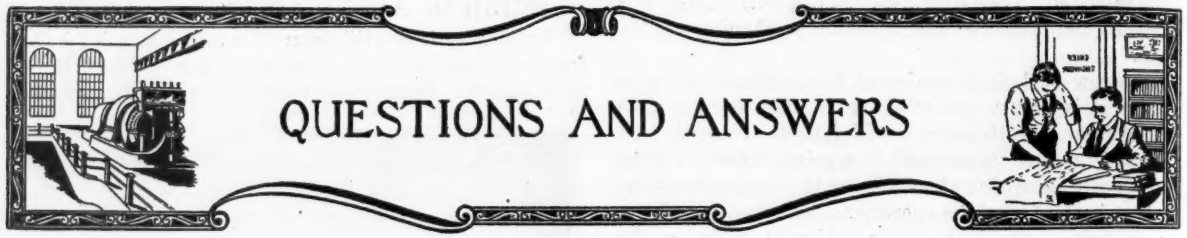


WORTHINGTON (KNOWLES) SIMPLEX BOILER-FEED PUMP OPERATING SINCE 1876 REPLACED TO PROVIDE GREATER CAPACITY

Late in 1926 when a larger unit was required, the old pump was removed from service and replaced by a larger Worthington pump. The entire repair cost during the 50 yr. did not amount to over $100; the valve motion was replaced only once during this time.

Marshalltown, Ia. GEORGE L. SUTER.

PLANS ARE under way, according to a recent report, for the construction of a new steam power plant on the Delaware River near Trenton, N. J., to be owned and operated jointly by the Pennsylvania R. R. Co., Philadelphia Rapid Transit Co. and the United Gas Improvement Co., all of Philadelphia, Pa. The new station, it is stated, will be designed primarily for power supply for railroad service, developing as part of the plan of the Pennsylvania R. R. to electrify its New York division. The Public Service Corp. of New Jersey will also be interested in the project.



# QUESTIONS AND ANSWERS

## Factors of Safety

WILL YOU kindly let me know how you find the factors of safety, as used in the boiler rule for finding the safe working pressure? E. S. D.

A. We presume you are referring to the formula $P_W = 2\ Ste \div f\ D$

where; $P_W$ = safe working pressure
S = tensile strength
t = thickness of shell
e = joint efficiency
f = factor of safety, usually taken as = 5
D = diameter of shell

Factors of safety are based upon the breaking strength, nature of the material and the kind and method of application of load. This is best illustrated by the accompanying table in which the proper factor of safety to be chosen for a gradually applied load on steel, when the action is only in one direction, is shown as 5 which is the factor chosen in the formula for safe working boiler pressure.

FACTORS OF SAFETY BASED ON ULTIMATE STRENGTH

| | | Repeated Loads | | | |
|---|---|---|---|---|---|
| | | Applied in one direction | | Applied in reversed directions | |
| | Dead Load | Gradually | Suddenly | Gradually | Suddenly |
| Wrought Iron or Steel | 3 | 5 | 10 | 6 | 12 |
| Cast Iron | 4 | 6 | 12 | 10 | 20 |
| Timber | 7 | 10 | 20 | 15 | 30 |

Factors of safety include a number of practical considerations such as possible imperfections in the material and varying structure due to manipulation during manufacture as well as known conditions of reduction of strength especially under sudden applications, which include shock; and applications in which the member is acted upon by a force or forces that tend to bend it in first one direction and then in the opposite direction. Authorities, therefore, differ slightly in the values for different conditions of application. The values given in the table have been tried out by many years of application and may be considered safe values.

## Boiler Problem Correction

ON PAGE 1347 of the December 15 issue, the answer to the question on the maximum amount of steam generated in a boiler was incorrectly based on the "combustible" rather than the coal as fired in which latter case we are not interested in the quantity of ash in the fuel. The corrected answer follows:

The question in the original statement was: Given a 72-in. h.r.t. boiler having 33 sq. ft. of grate surface and operating under natural draft, the coal used averages 14,200 B.t.u. per lb. The feed water is 200 deg. F. What would be the maximum amount of steam that could be generated when hand-fired?

A. Assuming the boiler pressure to be 100 lb. per sq. in. absolute pressure, we find, by consulting steam tables, the total heat in 1 lb. of steam at this pressure to be 1186.3 B.t.u.

Feed water temperature being 200 deg. F., the total heat supplied to 1 lb. of steam under given condition would be 1186.3 — 200 + 32 = 1018.3 B.t.u.

B.t.u. in coal given is 14,200. Assuming an efficiency of boiler and grate to be 65 per cent, which would be a liberal assumption for condition stated, the actual amount of heat transferred per lb. coal will be

$$\frac{14{,}200 \times 65}{100} = 9230 \text{ B.t.u.}$$

Assuming maximum rate of firing by hand to be 30 lb. per sq. ft. grate surface per hr., since grate surface is 33 sq. ft., rate of combustion may be as high as $30 \times 33 = 990$ lb. per hr.

Under these conditions, the heat that may be transmitted per hr. to the water is $990 \times 9230 = 9{,}137{,}700$ B.t.u.

The limiting quantity of water that may be turned into steam under conditions assumed would then be

$$\frac{9{,}137{,}700}{1018.3} = 8973 \text{ lb. per hr.}$$

## Safety Device Prevents Engine Troubles

IN THE JANUARY 15 issue of Power Plant Engineering, page 161, the question is asked by L. E. D., "How can a Corliss engine be made safe to run with the governor stop pin in place?"

Most types of engines can be made safe to run with the governor stop pin in place, provided they have a safety stop device independent of the governor. There are numerous devices of this kind on the market at the present time, some consisting of an arrangement whereby the engine throttle valve is automatically closed, in case of overspeeding, thereby shutting off the steam. Another consists of an independent valve installed in the steam line near the throttle valve, and so arranged that it automatically closes in case of overspeeding of the engine.

Ordinarily we would say that since the governor stop pin is provided as a safety precaution we would not want to try to run with it in. At the same time, we find in actual practice that there are certain conditions when it becomes necessary to run with the governor stop pin in place if we would carry the load and keep the engine running.

In a certain power plant there were times, especially during the winter months, when the lighting load would come on before the mill load had dropped off, overloading the engines. During these periods, the engines were always run with the governor stop pins in place and it would be noticed that the governors were continually dropping down to the pin and then riding clear again as the load varied. In this particular case, if the pins had not been in place the governors might have dropped so low that the valves would not have been able to hook on, and the engines would have shut down. As a safety precaution, independent safety stops were installed on the engines which, in case of overspeeding from any cause, would automatically close the throttle.

There are also cases in manufacturing plants where, at certain times, a condition may arise when it becomes necessary to run with the stop pin in place for a certain length of time.

In a certain plant in which boilers were generally run at full capacity, at times an extra demand was made for steam for process work. At such times, the steam would drop so low in pressure that the engine would lag and the governor drop. Unless the stop pin was put in place, it would drop so low that the valves would not hook up. Of course this meant a drop in speed, but the engine could be kept running until the firemen had time to recover and raise the steam pressure.

Lowell, Mass. E. C. WELLS.

## Examination Question Contest

ANSWERS to 15 of the questions have been published in the two preceding issues. The following concludes the report on this contest. Comments by any of our readers on any of these questions are desired.

16. What are the comparative rates of combustion for natural and forced draft?

A. For natural draft, 15 to 25 lb. per hr. per sq. ft. of grate. For forced draft, 40 to 60 lb. per hr. per sq. ft. of grate.

17. Explain the operation of a surface blowoff valve.

A. A surface blowoff valve is fitted with a scoop shaped fitting placed 3 or 4 in. below the normal water level. When the valve is opened a whirling effect is set up. This eddy draws the scum from the surface of the water.

18. Describe grate bars with which you have had experience.

A. The grate bars with which I had experience were of the shaking and dumping variety. They consisted of four sections of grate bars. All the bars in each section were pivoted and connected to a common shaft by levers extending downward on the outside end of the bar. The common shaft from each section extended through the boiler front and was connected to a vertical pivoted lever. This enabled the fireman to shake or dump each grate section separately by moving the lever varying amounts.

19. Where is the steam pipe connected to a water tube boiler? To a locomotive boiler? To a horizontal boiler? To a vertical boiler? Why?

A. a. Near the middle and at the top of the highest drum if there are several.

b. At the steam dome.

c. Near the middle and at the top of the boiler.

d. At the top of the boiler at the highest point in the steam space above the water level practicable.

e. In order to secure as dry steam as possible.

20. Describe a blowoff tank and name the connections from the boiler to the discharge pipe from the tank.

A. A blowoff tank is an open or vented tank connected to the blowoff from the boilers and to the sewer. Its purpose is to prevent the water from the boilers being blown into the sewer under pressure. The connections are: nipple, elbow, long nipple blowoff valve, nipple, quick opening valve, run of pipe containing expansion bend and blowoff tank.

21. How would you find the horsepower of a boiler? Illustrate, using your own figures.

A. A boiler horsepower is the evaporation of 34.5 lb. of water per horsepower from and at a temperature of 212 deg. F. into steam at that pressure.

B.hp. $= F\ W \div 34.5$

where W = amount of water evaporated in lb. per hr.

F = factor of evaporation = the ratio between the amount of water evaporated per hr. corresponding to the absolute steam pressure at 212 deg. F. and what would be evaporated per hr. if the pressure was 14.7 lb. per sq. in. and the temperature of the water was 212 deg. F.

$F = H - h \div 970.4$ where H = total heat of steam corresponding to the steam pressure used.

h = heat, above 32 deg. F. in the feed water.

970.4 = latent heat of vaporization of water at atmospheric pressure.

Assuming the amount of water evaporated per hr. to be 10,000 lb. with feed water at 212 deg. F. and steam pressure at 140 lb. absolute.

$F = H - h \div 970.4$

$= 1192.2 - 180 \div 970.4 = 1.043$

B.hp. $= F\ W \div 34.5$

$= 1.043 \times 10{,}000 \div 34.5 = 302.32.$

22. How would you determine the size of the feed pump needed, from the heating surface of the boiler?

A. Divide the heating surface of the boiler by 10 to get the b.hp. Multiply this by 34 to get the pounds of water per hour needed. The pump should be of a capacity sufficient to deliver at least 50 per cent more than this amount per hour.

23. Describe how a steam gage works and tell how you would care for it.

A. The ordinary type of steam gage contains a semi-circular piece of copper tubing of elliptical cross section. This is closed at one end and connected to the high pressure steam from the boiler at the other. The pressure tends to cause the copper tube to straighten out, in proportion to the amount of steam pressure. This movement is transmitted to the pointer by means of levers and gears, causing the pointer to move around.

A steam gage, properly installed, requires little attention except testing for accuracy at regular intervals. It should be installed with a water pocket in the line just below the gage so that the working parts will be protected from the high temperature of the live steam.

The gage should be watched closely for evidences of sticking. If the pointer stays in one position for any considerable length of time, it should be regarded with suspicion.

# EDITORIAL COMMENT

## Combination of District Heating and Electric Power Plants

During the past few years there has been a constantly growing interest on the part of central heating engineers in the possibilities of combined heating and electric plants. This interest has been aroused partly by the realization that the district heating business, although in some cases it has grown to large proportions, has not attained the success promised by its auspicious beginnings and has been far outdistanced by the public utility electric business. Interest has also been aroused by the opinion sometimes expressed by consumers that rates are higher than they should be, although the rates now in force are probably the minimum possible under present conditions; this fact, however, creates considerable sales resistance. In any event, district heating engineers are seriously considering the by-product plant, that is, the one in which district heating steam is obtained from the exhaust of a back pressure turbine driving an electric generator.

One reason for this is the recent development of back pressure turbines with comparatively low water rates, as a result of the demands from industrial plants needing process steam. Such units have been installed in several district heating plants where conditions were right and the by-product power so produced fed into the system of the electric utility. This additional electric capacity may be used as peak load capacity by the power plant, the value of this peak load capacity being high. The combined value of the two commodities when produced together may be very high as compared with separate operation.

From past experience it would appear that such combined operation is best when the electric utility controls the heating utility or is willing to co-operate closely with it. The various ratios of investment in generating plant and distribution equipment for heating have not always appealed to public utility executives in the same way and to some of them it has appeared that costs were high in proportion to annual earnings. But experiences in Detroit, Rochester, Kansas City and other cities have shown the possibilities with conservative design and good management. A study of the data on this subject given in the 1926 report of the heating research committee of the N. D. H. A. will prove of interest to electric central station engineers and to all industrial engineers as well as to the district heating man.

It is certain that the next few years will see great changes in power plant practice. Improvements in equipment may bring about the economic desirability of building a public utility electric plant in which some of the generating units will operate condensing to take the normal load and the necessary peak load equipment will supply exhaust steam for district heating and peak load electric power when it is most needed. This problem of balancing the steam load and power demands and buying the surplus power has been solved by many industrial plants and we see few reasons why it cannot eventually be solved by the public utility. Developments in coal utilization may even bring about the design of plants in which the production of coal by-products, illuminating and industrial gas, district heating steam and electric power, can be carried on together, with extremely high financial efficiency, as has been suggested recently. Whatever arrangement emerges, it will be interesting. We are convinced that something of this kind will come sooner or later.

## Industrial Aspects of College Education

Controversies regarding the relative merits of college and non-college men usually lead into a backwash of unsupported statements drawn from more or less narrow and often prejudiced personal experiences.

To state definitely that a college training is a prerequisite of, or even a stepping stone to, success is as narrow as to take the opposite view that it is a detriment. Rather it is a sugar-coated method of getting the rudiments of an education and we believe that we are safe in saying that, without this sugar coating, many men now considered educated would be doing manual labor because they lack the backbone to acquire that education in any other way.

In our present industrial system leadership must be won by training and capacity with little regard to the method by which that training has been acquired. From a report to the Chamber of Commerce of the United States we learn that "of the 29 heads of our more important railways, 28 came from the bottom. Thirteen of them were college graduates who were content to begin their business careers with low wages and long hours."

So much for the last generation with success or failure definitely determined, but how do they in turn look back at the coming generation? This question is answered rather pointedly in a communication sent out by the Associated Industries of Massachusetts to some 1600 member firms.

"Your active co-operation is needed in saving for New England the cream of her college graduates each year. In your firm, with its average annual turnover of 20 to 60 per cent of your working force, opportunities of an excessive character are continually presenting themselves. These young college graduates and juniors selected by us will go into your organization prepared to serve their apprenticeship on the job in overalls. Surely there is room for one such apprentice each year to every 100 employees. If an opportunity comes to use his services in an executive capacity and he is the right man, then we have saved for New England the skill

and ability he represents. If no such opportunity appears and he eventually goes on to some other organization, you are always certain that in the meantime he will have more than earned his salt in doing the work assigned to him."

If this large organization, viewing the matter in a purely mercenary light, feels that with one per cent of their employees college trained they are in a better position to fill executive positions, it would seem that the colleges are doing their part and more than justifying their existence by this one item alone.

## Open Publicity

In connection with graphical presentation arises the question, How much shall we tell? In recent conversation with a fine gentleman of the old business school, he showed a balance sheet for the year which left only 3.5 per cent return on the invested capital, a conclusive argument against the advancement of wages or reduction of prices. There was no chance whatever for the establishment of a reserve fund, that essential insurance feature which must be created, if a business is to be on a sound basis.

To the suggestion that the balance sheet be made public to correct the idea as to the huge profits in coal, he exclaimed in astonishment, "Oh, my God, no." To him the balance sheet was secret and sacred, although no harm could come from its publication.

The day of secret processes and "Keep Out" signs is past, and manufacturers are swapping methods, spending large sums to educate the public as to the real conditions and facts of their businesses and hanging out signs, "Visitors Welcome." One of the results is the doing away with special dies, gages and standards, which are recognized as wasteful, and adoption of simplified practices. Another, which can be brought about by making public financial facts and figures, will be the realization of the public that no business can long make more than a reasonable profit, as competition will enter to reduce prices. And the members of an organization, who know that the management is securing only a fair return for its investment and effort will be much less likely to make unreasonable demands as to wages, hours and privileges.

## Off Duty

No word in the English language is more abused today than the word "science." More nonsense is perpetrated under the guise of scientific method than under perhaps anything else with the possible exception of politics. To be in vogue today things must be "scientific" and all activities from the making of home brew to the determination of sales resistance in the selling of bath tubs in Tibet is conducted under the holy name of research.

Whenever things get too warm at home for the local politician, he suddenly is stricken with altruistic ideals and goes forth on a scientific expedition to some safe spot to study the nocturnal habits of the tree climbing fish or to bring back the second dorsal joint of the Brontosauris. Every retired plumber or janitor sooner or later goes on a trip to the Orient to gather material for a scientific work on the philosophy of Ho Hen.

Now we have no particular objection to giving science its due in the world, in fact, we can think of no more worthwhile human occupation than the pursuit of scientific research but, when every tinsmith advertises his shop as a research laboratory and when every retired dollar-a-year man refers to his pleasure trip to Paris as a scientific expedition, it would seem the thing is being carried to absurdity.

There is a distinct difference between scientific research and monkeying. Most people like to tinker or monkey but only a few have the required rare ability to engage in any occupation worthy to be called research. An excellent example of the relative effectiveness of research and monkeying is to be had in the development of radio equipment. Five years ago, when radio broadcasting first made its voice heard, thousands of people began to tinker with radio equipment. The variety stores supplied the parts and the kitchen became the laboratory of every clerk, salesman, engineer and editor (yes, we admit it) imbued with the creative impulse. To most of these people precedent meant nothing and some of the things they did must have made the angels laugh. They were ignorant of all fundamental knowledge and many seven dollar tubes went west. Night after night they toiled, building up and tearing apart. Loads of junk were carried out to the ash can every morning but in the evening the squeals from the loud speakers were louder than ever. From this group improvements in radio were few.

In the laboratories of the better electrical manufacturing concerns and in the private laboratories of experienced radio amateurs, however, something different was happening. Here men with basic knowledge were also engaged in building radio equipment but their methods of procedure were quite different. They were more deliberate and usually had a definite plan of attacking the problem they were working on. They wasted little time in guessing—exact measurement governed their activities.

The outcome of the situation was that practically all of the important radio developments of the past five years have come from the relatively small group of men in the laboratories—the trained research workers. The kitchen radio mechanics are still tinkering but they know little more about the subject than they did five years ago.

What is true of radio in this respect is true of all modern discoveries. Whether it be in the making of gum drops to the building of power plants or the design of automobiles, all the great advances are made by a relatively small group of people who have the ability to employ scientific method.

The same is true of scientific exploration. The real discoveries in anthropology and geology are not made by retired aldermen or captains of industry but by trained scientists whose writings rarely get into the newspapers or popular periodicals. Neither are important scientific works in biology and psychology written by ex-newspapermen or clergymen but by biologists and psychologists who have spent their lives in these respective fields.

Tree climbing fish may be interesting creatures, well worth observing, and the search for prehistoric whifflebirds may lead one into interesting parts of the world, but when ex-pugilists solemnly inform the newspaper reporters that their quest after these creatures is in the interest of science, we don't know whether to laugh or weep.

# Power Show Reflects Progress of the Industry

SEVERAL NEW BOILER DESIGNS AND THE GENERAL TENDENCY OF ALL MANUFACTURERS TO EXTEND THEIR LINES TO THE HIGHER PRESSURE AND TEMPERATURE RANGES CHARACTERIZE THE SECOND CHICAGO POWER SHOW

TWO HUNDRED and sixty-three exhibitors in 350 booths combined with 15,555 registered visitors to make the Second Annual Chicago Power Show, held at the Coliseum, February 15 to 19, a success. Progress and developments by the power plant industry were reflected in practically every exhibit.

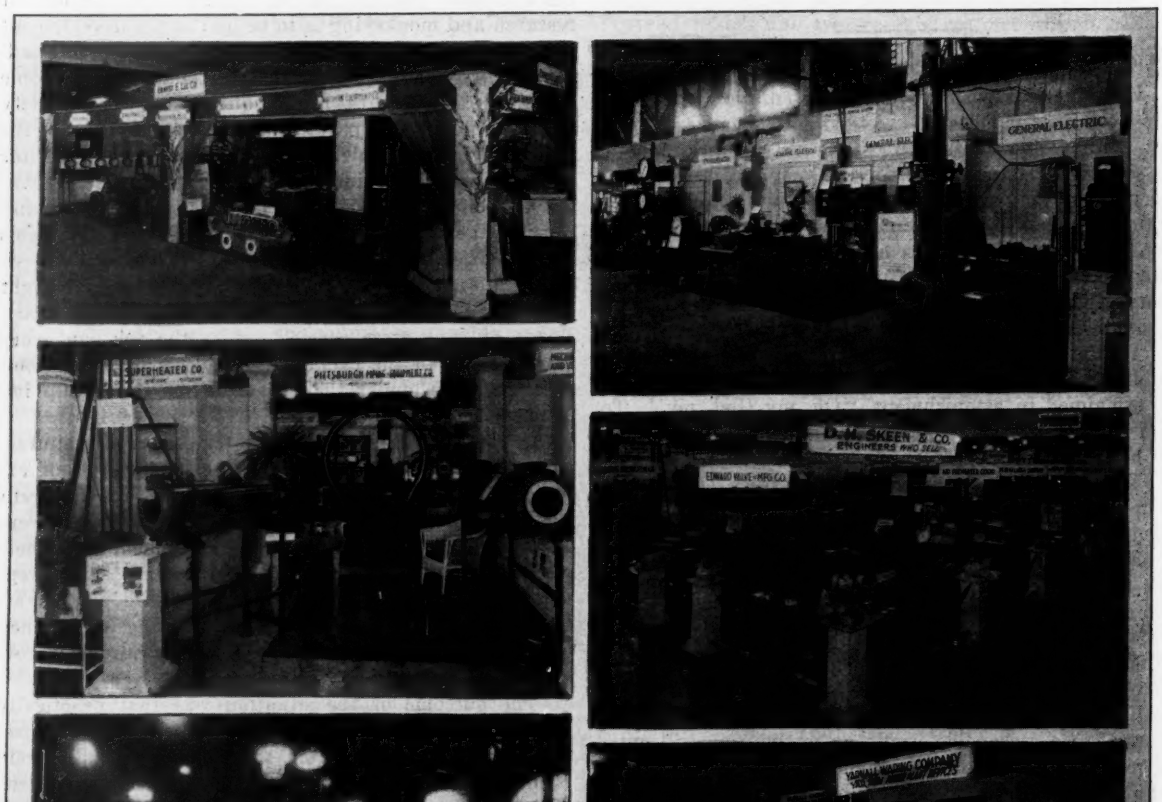



FIG. 1. THE LARGE NUMBER OF ATTRACTIVE AND DISTINCTIVE EXHIBITS FEATURED THE SHOW

One of the most interesting features of the show was the large number of exhibitors displaying equipment which had been or will be installed in actual installations. Superheater tubes which had been in service for 20 yr., displayed side by side with modern tubes, to show the changes which have taken place in manufacturing methods, boiler feed pumps, check valves, feed water control and other apparatus and going into the Waukegan Station and into Crawford Avenue Station gave engineers an opportunity of inspecting details which could otherwise be obtained only by visiting the stations. A motor valve control panel on its way to the Bennings Station, a model of the turbine and condenser for Waukegan, electric switching and control apparatus, a new type of oil filter, and many new lines of valves designed to meet high pressures were exhibited and allowed one to compare the relative advantages of each for definite conditions of service.

In the heating and ventilating field, unit air heaters, heat cabinets, concealed radiators, many new valves and traps and a new differential pressure heating system broadened the show. For the industrial engineer, a number of roller bearing exhibits, speed changers of various types, lubricating devices, lubricants, and gears and chains, played an important part. A meter developed to measure the heat transfer through walls was exhibited and a small display of photo-electric cells, the present basis of television, proved to be of unusual interest to visitors. In the refractory field, a number of new bricks, developed to meet specific conditions brought about by recent furnace developments were exhibited and a new refractory gun weighing less than 4 lb. was demonstrated.

Developments were confined largely to the boiler room, electrical equipment and piping. Several new stokers, improvements in pulverizers, burners and coal-handling equipment, and Vanstone joints from wrought iron were other important announcements in this field. Many of the new features are confined to the smaller equipment, illustrating developments and refinements taking place to meet the conditions of higher pressures, higher temperatures and higher boiler rating largely responsible for tremendous changes in the power plant field in recent years.

### Many New Centrifugal Pumps Announced

Throughout the entire show there was a decided trend toward automatic operation, safety features and rugged designs. This was particularly noticeable in the new developments of valves, where practically every manufacturer of valves of over 6 in. made provision for motor drive, bypass connections, ball bearings and pressure lubrication. Centrifugal pumps for every service were on display, many of them operating so as to show their action in service. Most of the smaller pumps are furnished throughout with ball bearings, an indication of the general trend towards anti-friction bearings in all types of equipment. A new type of single flow, reversible flow, condenser was exhibited in model form and a new 3-stage steam jet pump for high vacuum use shown. As an indication of the tendency toward the use of raw water on the intercoolers of steam jet vacuum pumps, a new design made so that the raw water section may be opened and cleaned while the unit is in service was illustrated by full-sized equipment.

Many other items of unusual interest were shown and although there has been no decided change or revolutionary practice introduced, it is evident that the higher pressures and temperatures are now accepted practice and all manufacturers are revising and changing their equipment to meet the new conditions. This is perhaps one of the best indications we have had that high pressures for both central station and industrial service are no longer an experiment and are here to stay.

### New Boiler Designs Exhibited

One of the most outstanding features of the show was the large number of new boiler designs announced. They were, with few exceptions, of the bent tube type, of two, three and four-drum construction.

Perhaps the most unusual of these was the new LaMont steam generator for direct-fired or waste heat use, sections of which were exhibited by the LaMont Corp. These generators have positive circulation, and the water sprayed in at the top of the vertical pipes flows downward over the inside surface in a film. For use with waste heat the company has developed a steam-sealed valve, sealed and cooled by steam in order to prevent warping of the valve by the high temperature gases.

Another interesting development was announced by the Nuway Boiler & Engineering Co. This was the Nuway water wall boiler, utilizing water wall construction in connection with its return tubular boiler. For higher pressures and rating the tubes are crossed under the boiler to protect it from the high temperature.

Wm. Bros Boiler Mfg. Co. had a small model four-drum boiler and announced its three-drum type. The latter occupies the same height and width as the horizontal return tubular boiler of the same horsepower. The four-drum type is built from 200 to 1600 hp. for pressures as high as 400 lb.

Walsh & Weidner Boiler Co. exhibited a section of a new 480-lb. pressure, vertical, forged steel header, made from seamless tubing and featured a new bent tube boiler design, a three-drum type with alternate rows of tubes in the first bank going to the first and second drum, in order to give large steam liberation. It is designed with an integral superheater and a large number of circulating tubes for the purpose of maintaining a steady water level in both drums regardless of rating.

A new three-drum bent tube boiler was announced by the Wickes Boiler Co. The boiler is designed for high pressures and as an addition to the line of horizontal and vertical water tube boilers now manufactured by this company.

A section of the header for the 1400-lb. boiler for the Edison Electric Illuminating Co. of Boston was displayed by the Babcock & Wilcox Co. and showed in detail the construction and design of headers used for the very high pressures.

Combustion Engineering Co. featured the 325,000-lb. per hr. generating unit installed in the Kips Bay Station of the New York Steam Corp. The Ladd boilers in this installation are installed vertically, giving a much greater furnace volume and allowing additional water wall construction.

In the booth of the Casey-Hedges Co. a glass working model, heated by electric elements was used to show the principles employed in the circulation system of the Multipass boiler.

### Coal-Handling and Drying Equipment

Synchronized and controlled by the same motor, a new skip hoist and tram car combination model displayed by R. H. Beaumont Co. created considerable interest and showed the construction and operation very well.

Accurate coal weights are important and a new chart recording instrument for use with the Merrick mechanical weighman was demonstrated by the Merrick Scale Mfg. Co. This recording instrument can be placed at any convenient point in the office or plant and gives a continuous record of the loads which pass over the scale.

The Dodge Mfg. Co. featured its new 36-in. steel reversing tripper for use with belt conveyors. It is automatic in operation with cut steel gears and friction

clutch, and equipped with anti-friction bearings throughout. All wheels are driven by worm gears, operating in oil-tight cases, and the slatted-wood pulley is used to prevent materials from building up and injuring the inside of the belt.

A new sectional cast-iron waste heat coal drier made up of small, uniform, standard cast-iron sections was featured by the Strong-Scott Mfg. Co.

Nichols heat flow meters, consisting of 144 thermocouples inserted in a plate about 18 in. square, were demonstrated by the U. S. Bureau of Mines Experiment Station. The plate is attached to the outside of the wall and the heat flow recorded on a strip chart. Another exhibit showed in detail the method of testing heat flow in boiler furnace walls by means of thermal couples inserted at various depths in the bricks.

BOTFIELD REFRACTORIES CO.
BUREAU OF MINES
The New Way of Making Steam
LA MONT CORPORATION
C. O. BADGER & SONS CO.
SOUTHERN PIPE & SUPPLY CO.

FIG. 2. REFRACTORIES AND BOILER ROOM EQUIPMENT WERE WELL REPRESENTED

### Refractories and Furnace Wall Construction

With any method of construction refractories are an important part of a boiler installation and many exhibits traced the improvements in this field. Many of these dealt primarily with construction of air-cooled walls and methods of introducing secondary air into pulverized coal furnaces.

Botfield Refractories Co. featured a new refractory gun weighing less than 4 lb. The ease of operation was demonstrated by spraying a small section of wall put up for that purpose with a mixture of adamant cement. Either air or steam may be used to operate the gun and it will handle anything from a fine dust to material which will pass through a number ten mesh.

With all vertical joints broken and the supporting section castings hung from horizontal beams, a new type air-cooled wall was featured by the American Arch Co.

M. H. Detrick Co. exhibited a new sectional supported wall for air-cooled furnaces with all tile held in place on vertical castings suspended from horizontal beams.

In the booth of the Liptak Furnace Arch Co. was exhibited the new Type F furnace wall construction, sectionally supported on the double suspended arch principle.

To take care of difference in expansion and contraction between common brick and plastic refractory lining, the Plibrico Jointless Fire Brick Co. developed its new flexo-anchor, which consists of a hook firmly secured in a common brick wall and a steel anchor loosely attached to the hook and imbedded in the plastic Plibrico.

Made in standard 9-in. fire brick size and weighing but 3 lb., the new Insulfrax brick with a softening point of 3300 deg. and a compression strength of 12.5 lb. per sq. in. at 2700 deg. F. was exhibited by the Bernitz Furnace Appliance Co.

The new Sil-o-Cel Super brick with high insulating and refractory qualities for use where the temperatures behind the fire brick may run as high as 2500 deg. F. was featured by the Celite Products Co.

The Walsh Fire Clay Products Co. exhibited a vertical gas retort head made in a single piece and weighing 1600 lb.

### Coal Preparation Machinery and Burners

Coal preparation equipment, especially for pulverized coal, is becoming of increased importance and the interest displayed in this type of machinery was marked throughout the show.

Featured in the booth of the Bethlehem Steel Co. was the new No. 5 pulverizer with a capacity of 20 t. per hr. Photographs of their new 2, 4 and 6-cylinder, solid injection Diesel engines now being built for stationary service with a range of sizes from 60 to 970 b.hp. were also shown.

Among other exhibits in the booth of Ernest E. Lee Co. was the American Pulverizer Co. with the American ring crusher, now being built with adjustable grinding plates giving a 2½ to 3-in. adjustment between the ring and the grinding plate. In addition the operation of the automatic apron finger system for the elimination of tramp iron was demonstrated. Application of rings to the well-known hammer crusher was shown by the Williams Patent Crusher & Pulverizer Co. both in a full scale and model machines. The crusher is now furnished with either hammer or ring, as may be desired, and is built with an adjustable breaker plate to take up wear and maintain a uniform product throughout the life of the crusher.

In the booth of the Fuller-Lehigh Co. a full-size Calumet pulverized coal burner was featured. This burner is made in capacities up to 8000 lb. per hr., the primary air and pulverized coal being blown into the furnace through a long narrow vertical spout between the water-cooling tubes. Secondary air ports are staggering and are at an angle to the primary air jets, giving a short turbulent flame.

Drawings and photographs of the Peabody Engineering Co.'s new triple burner for oil, gas or pulverized coal were featured by this company, in addition to full-sized oil and combination oil and gas burners on exhibition in the booth.

### Stokers and Boiler Room Auxiliaries

Working exhibits of the Burke traveling grate stoker and the new underfeed stoker, known as the improved Roach, were shown by the Burke Engineering Co. The new stoker is of the single retort form with side ash dump and is characterized by hollow-faced bars through which the air for combustion is delivered.

Low installation cost and heavy interchangeable construction were featured by the Auburn Stoker Corp. in exhibiting a full-sized, full-mechanical Auburn Stoker built in three types, hand-operated, semi-mechanical and full mechanical, for either natural or forced draft.

In the booth of the Riley-Stoker Corp., a full-sized No. 3 Atrita unit pulverizer was shown with motor drive and the cover removed to show the construction. A primary stage with manganese steel hammer heads has been added and the pegs in the second stage and the second head with pegs increased from 2 to 2½ in. in diameter. The Riley flare-type pulverized coal burner was featured, a full-sized burner showing the arrangement of the coal, primary air and secondary air inlets and the method used to insure thorough mixing. Changes on the Riley stoker were shown by means of a full-size stoker.

Construction and operation of grates and apparatus for burning wood waste and sawdust were exhibited by The M. A. Hofft Co. Sections of the new step cut grates were on exhibit and a screw conveyor for feeding sawdust or refuse were shown by photographs and drawings. Installations at the Federal Light and Traction Co. and the Hercules Powder Co. plants were featured.

One of its new single-stage, double-suction type SF pump designed for heads up to 500 ft. was explained by the Buffalo Forge Co. In addition the company showed one of the high pressure blower and exhauster units, which are built either for vacuum or pressure up to 6 lb., in 4, 5 and 6 stages.

Tubular air heaters, new propellor-type forced draft fans and a new induced draft fan were featured by the Sturtevant Co. For capacities up to 40,000 c.f.m. with 5 in. of static pressure, a new propellor-type forced draft fan which requires little space and can be installed under limited space conditions is being offered.

The Furnace Engineering Co. featured one of six pulverizers which will be installed in the new Kalamazoo plant of the Consumers Power Co. In addition, details of construction of the cast-iron furnace floor, the cast-iron facing of which is now made integral with tubes were shown.

The first unit pulverizer to be used afloat was exhibited by the Power Specialty Co. This is a 2000-lb. Aero pulverizer, and will be used by the Inland Waterway Corp. on the Mississippi River. This company featured, by means of drawings and design data, the new Whippany Station of the Jersey Power & Light Co. Several superheater units 20 yr. old were exhibited.

Two of the superheater units to be installed in the Springfield cross-drum boilers at the Kalamazoo plant of the Consumers Power Co. were featured in the booth of the Superheater Co. This plant will be designed to give 250 deg. of superheat at 260 per cent of rating and 400 lb. pressure and the elements were exhibited side by side with others taken from Hellgate and the Fordson plant.

A miniature boiler in the booth of the Diamond Power Specialty Corp. demonstrated the principles of correct application of soot blowers for varying boiler conditions. In addition the company showed metals used in its soot blower element and called particular attention to the new calorizing process, which is now used to give deeper penetration of the treatment with a correspondingly higher heat resistance.

Adjustable breeching cover attachments and improved connections were exhibited by Connery & Co. The former consist of clip and rods especially adapted to the construction of the Connery breeching to facili-

tate the application of insulation. The connections consist of electrically welded steel forms for use with concrete or brick stacks, and provide for vertical and horizontal expansion.

A type of stoker with fingers which come up through the fire for the purpose of breaking up the fuel bed was exhibited by Slicing Stokers, Inc.

### Miscellaneous Exhibits Which Added to the Value of the Show

Applications of the Williams Form Clamp for securing concrete forms for all kinds of concrete work were explained by the Williams National Form Clamp Co.

Lacing an 8-in. belt in 1½ min. with one of the new No. 8 lacers was a feature at the Clipper Belt Lacer Co.'s booth.

Details of construction and a heater in actual operation were shown at the booth of the Instant Water Heater Sales Div., featuring the new Type 26 copper tube steam water heater with a capacity of approximately 2½ times that of the old type.

Joseph Dixon Crucible Co. featured its new aluminum graphite paint developed primarily to meet the requirements of gas, oil and industrial companies desiring an aluminum or light-colored paint which would at the same time protect against gaseous fumes, ashes, smoke and natural agents.

Coils, bends and floats of various sizes and shades were shown at the booth of Arthur Harris & Co., where the new monel metal floats recently added to its line were featured.

Various devices for lessening vibration and noises of operating machinery were demonstrated by the Korfund Co., and a cross sectional model of its recently patterned vibro-damper was shown.

R. D. Nuttal Co. exhibited a new full-size speed reducer unit with single helical gears, anti-friction bearings and splash lubrication.

The Reeves Pulley Co. featured a new vertical-type transmission designed especially for conditions of limited floor space.

Heavy duty worm gear speed changers built in sizes up to 200 hp. with anti-friction bearings, extra large casing and splash lubrication were exhibited by the W. A. Jones Foundry & Machine Co.

Link-Belt. Co. featured a double herringbone speed reducer built in single or double reduction with speed changes as high as 80 to 1, and showed the new anti-friction multi-roll idler, with roller bearings and pressure lubrication. The Caldwell-type, self-contained car puller, a self-lubricated unit especially designed for small plants where the investment of a larger car puller is not warranted, created considerable interest.

Magnetic clutches were featured by the Magnetic Mfg. Co. in the booth of Paige & Ludwick. A full-sized clutch set up in the booth showed the details of construction and the application to various services.

A new flexible coupling was announced by W. H. Nicholson & Co. This coupling consists of steel keys immersed in oil and floating in dove-tailed slots in the two hubs. In addition the company exhibited a model of its piston-operated steam trap, featuring the changes which have been made, particularly the addition of a bypass allowing the trap to be blown down at any time.

Sight feed gage glasses, a one-piece brass oiler and a slow wire feed wick oiler were shown in the booth of Gits Bros. Mfg. Co.

One of the large roller bearings now being used on roll necks in steel mills was exhibited by the Timken Roller Bearing Co. This bearing with a 17-in. diameter bore and 26½-in. outside diameter, is 13 in. wide and capable of carrying a load of 8500 lb. A standard railroad bearing, with a 5-in. bore and 11⅝-in. outside diameter of the type now being used on railway car axles was exhibited.

The De Laval Separator Co. exhibited one of its new No. 900 oil purifiers with a capacity of 1200 to 1600 gal. per hr. and demonstrated the action of the equipment in the handling and purifying transformer and turbine oils.

In addition to a No. 6 Sharples portable separator for the purification of transformer, turbine and general lubricating oil, the Sharples Specialty Co. exhibited an actual model of the Samplit, a device to be installed in oil lines for the purpose of automatically sampling the oil going through.

A new model heat exchanger was exhibited by the O. E. Frank Heater & Engineering Co. This is built with a dividing shell, divided tube head, removable baffles and rolled tubes arranged in four passes.

Oil purification by means of the new Diskelectro was demonstrated by S. F. Bowser & Co., Inc., by continuously purifying a sample of badly contaminated oil. The Diskelectro consists of a number of very thin metal disks separated by electro plated spots approximately 0.00042 in. thick.

Improved construction of its grating with a double crimp was demonstrated by the Irving Iron Works by means of a stairs and platform constructed with Vizabledge Safstep and the standard Safstep construction.

Blaw-Knox Co. featured its security steel grating made with integral construction and forged steel bearing bars, giving an absence of sharp corners and allowing a maximum amount of light to pass through in a longitudinal direction.

C. H. Wheeler Mfg. Co. showed a three-stage Radojet for high vacuum and in addition featured a new design of two-stage Radojet designed with surface inter and after coolers for both condensate and raw water circulation systems. By means of special construction the raw water tubes can be cleaned while the pump is in operation.

Reversing the water flow in condensers was advocated by Wheeler Condenser & Engineering Co. and the model of a new design shown. This is a single pass condenser divided into two sections and supplied with water from two circulating pumps. By reversing the stop valves at the top and bottom of both ends, the flow of the two sections is reversed, washing out debris which has collected in the tubes.

### Packing of Many Kinds on Display

A complete line of soft packing was featured by the Chicago Ropac Products Co. and a packing testing machine exhibited at the booth created considerable interest.

By means of a small model condenser the new John Crane metallic packing for condenser tubes was demonstrated by the Crane Packing Co. Rings of metallic packing are alternated with fibre packing for the pur-

pose of allowing the tubes to expend and contract freely and the use of ferrules is abandoned.

Worthington Pump & Machinery Corp. featured one of the motor driven boiler feed pumps of the type used by the Milwaukee Electric Railway & Light Co. and the Edison Elec. Illum. Co. of Boston in its high pressure service. The pump shown was one of three being furnished to the Waukegan Generating Co. for the Waukegan Station. Two of these are motor driven and one turbine driven. In addition an Axiflo sump pump, a compact unit made in sizes from 100 to 500 g.p.m. for heads of from 5 to 70 ft., and new design Type R and Type L pumps were shown. The former is built in 1½ and 2-in. sizes for low head, the latter in 3, 5 and 6 in. for pressures up to 280 ft. Both pumps have ball bearings throughout, and are furnished for 1800 and 3600 r.p.m. motor or turbine drive.

In its exhibit of steam turbines, reduction gears and flexible shaft couplings, the Terry Steam Turbine Co. featured its small turbine built for speeds of from 2000 to 6000 r.p.m. in a range of horsepower from 1 to 35. Ball bearings are used throughout with a standard Terry wheel. Back pressures as high as 30 lb. can be taken care of and the units are built for pressures up to 400 lb. per sq. in.

Demonstration of the Cooke seal ring packings were

FIG. 3. MANY OF THE EXHIBITORS DISPLAYED EQUIPMENT WHICH WILL SOON BE IN SERVICE IN PROMINENT STATIONS

exhibited in the booth of the Cooke Seal Ring Co., showing the construction and operation of this ring in which the packing turns with the shaft and the seal is maintained by a ground joint, the entire mechanism revolving in a bath of oil.

A new centrifugal boiler feed pump for small plants was featured by the Ingersoll-Rand Co. This is the new Type TV for high speeds and high pressures and is made with a capacity of 200 g.p.m. against a head of 200 lb. per sq. in. It is intended to complete the line of boiler feed pumps and cover the range below the capacity of the regular high pressure boiler feed pumps. One of the latter, built for 900 g.p.m. against a pressure of 800 lb. per sq. in. and driven by a steam turbine, was exhibited. This pump is intended for Crawford Ave. station of the Commonwealth Edison Co. and is equipped with a Kingsbury thrust bearing, an external oil cooler and a geared oil pump. Methods of dividing its single pass-condenser into four sections for the purpose of steam distribution was also demonstrated by means of photographs.

In a distinctive and original booth the Nash Engineering Co. showed a number of machines and announced a new self-priming centrifugal pump, designed with a standard centrifugal pump impeller and, in a separate compartment, a vacuum pump impeller for the purpose of pumping the air out of the suction line.

Fairbanks, Morse & Co. featured its new Type VHL hollow shaft vertical motor designed for pump service without a flexible coupling between the motor and the pump, the motor carrying the entire load on ball bearings. It also had on exhibition one of the new Type CO marine Diesel engine-generator units.

### Heating, Ventilating and Air Conditioning Devices

Crown ventilators, to be installed under seats in churches and auditoriums for the admission of fresh air, were shown by the Clarage Fan Co. A new steel inspection door, measuring 31 in. high and 17 in. wide, designed for installation in sheet metal work for heating, ventilating, air washing and humidifying systems was demonstrated.

Operation and efficiency of the new stream line automatic self-cleaning filter were demonstrated by the Reed Air Filter Co. This is a new self-cleaning filter with vertical stream line elements covered with a thin layer of viscous oil.

Air filter units of a new type were featured by the American Blower Co. They are the dry plate type, made in a unit type weighing 4½ lb. and consist of ten or more perforated aluminum plates coated with treated cotton.

Industrial unit heaters were exhibited by the Bishop & Babcock Sales Co., a full sized Type C Massachusetts unit, having an air filter, humidifying control and a new helical fin radiating surface, was used.

In the booth of the Johnson Service Co., the control mechanism of the dual thermostat system of temperature and humidity control was demonstrated. This control is designed to allow a comfortable temperature to be maintained in the rooms in service, while the heat in the unoccupied portion of the building may be reduced and maintained at a lower temperature.

Weighing approximately 170 lb. and occupying 4 cu. ft., a small unit heater was featured by the Hermann Nelson Corp. for use with pressures up to 125 lb.

Among the exhibits in the booth of the J. W. Murphy Co. was an Esterline-Angus Co. quick trip attachment for speeding recording charts from 1 in. per hr. to 1 in. per sec. In the booth of the same company a States automatic time switch was demonstrated. A synchronous motor driven clock is used and it may be fitted with astronomic regulation dial automatically to turn on and off lighting circuits according to the time of the year.

Manufacturing of fin type tubes without the use of solder was featured in the booth of the Griscom-Russell Co. The tube is grooved, the fin then pressed in and the sides crimped. This allows a higher temperature range as there is no solder to melt.

### Electrical Equipment Forms Important Division

Exhibiting a complete turbo-generator unit for the first time at this show, the Elliott Co. called attention to the fact that it is now able to supply steam turbines, gears and generators as a complete unit.

Chrome nickel steel gate valves and fittings for high pressures and temperatures were exhibited in the booth of the Chapman Valve & Mfg. Co., featuring the new type limit switch for use on electrically driven valves.

Various uses of monel metal in commercial forms were exhibited by the International Nickel Co., with particular attention being called to the latest use to which monel metal has been put, in connection with bolts and nuts in outside electric distributing equipment, where the high tensile strength and non-corrosive qualities of the metal make it particularly desirable.

The Rowan Controller Co. featured its new Type 9000 oil immersed impedance starter with press button control for alternating current, squirrel cage induction motors.

Among the exhibits of the Cutter Electrical & Mfg. Co. was one of the new Tri-Closite circuit breakers which, when tripped, automatically recloses twice and stays out after the third time. In addition they exhibited a three-pole carbon circuit breaker arranged for solenoid operation and non-closable on overload at any point of the closing stroke.

In addition to its valve control equipment the Cutler-Hammer Mfg. Co. exhibited its new Type C starters for 100 hp., a primary resistant starter No. 9605 for capacities up to 40 hp., and an auto transformer starter, No. 9621, built up as high as 30 hp., all being equipped with thermal overload protection.

A new motor starter known as Type E17 was exhibited by the Condit Electrical Mfg. Co. together with a new type JH7 relay. The motor starter is entirely enclosed and of fool-proof construction so designed that it must be operated in proper sequence.

Air break switches were featured by the Delta Star Electric Co. with one of the new Type MA-39 on exhibit. The blade is drawn horizontally backward to break the ice, then snapped quickly open. Springs are provided for taking the shock of compression when closing.

A new panel board type of instrument was exhibited by the Jewell Electrical Instrument Co., featuring a larger reading dial gage of rugged construction. Inserts are molded in bakelite, no wire connections are used, and interchangeability of parts featured.

Actual operation of a Reyrolle oil type switch was featured by the Allis-Chalmers Co. This is a complete switch unit with meter transformers and disconnects in a single case entirely enclosed. Bus bars are in steel

shells filled with insulating composition so as to make it impossible for the operator to come in contact with live wire. This company also exhibited its Type ARY squirrel cage and Type AR slip ring motors, self-ventilated and entirely enclosed. A ⅛-sized model of the new 50,000-kw. Allis-Chalmers turbo-generator with a 67,000-sq. ft. condenser for Waukegan station was also exhibited.

Among the exhibits of the General Electric Co. a small demonstration of photo electric cells occasioned a great deal of interest. Among the other exhibits was a complete automatic synchronous motor starter, built in sizes of from 20 to 200 hp., a new enclosed motor for both a.c. and d.c. service and their new instruments for use with the electric flow meter. A demonstration panel with one of the old and one of the new flow meter indicators showed that the new type was independent of voltage changes over a range of from 70 to 120 v. A phase failure relay was also demonstrated to show the operation on an open or reversed phase.

The Westinghouse Elec. & Mfg. Co. featured one of its new single-retort underfeed stokers for either motor or steam drive. The new B26 type oil circuit breaker for heavy circuits as high as 30,000 amp. was also exhibited, and the new non-condensing turbines, Type AND and Type EHNC, were shown featuring the new restraining ring blade as an added protection against overspeeding and failure of the safety device.

Dexter valve reseating machines for globe and gate valves were exhibited by the Leavitt Machine Co. and a new 36-in. valve reseating tool was featured together with improvements which have been made. New cutters to handle monel metal and new methods of grinding tools so that they are self-centering were shown.

Control panels with mimic piping which will be installed in the Bennings Station of the Potomac Electric & Power Co. of Washington, D. C., were shown by the Liberty Electric Co. A safety clutch and flexibility arrangement of the equipment was featured by models of equipment and photographs of motor operated valves.

### Valves, Traps and Piping

A new 900-lb. extra heavy steel trap was featured in the exhibit of the Armstrong Machine Works and the operation of other traps explained by cross sectioned models.

New rapid water feeders with a Mercoid cutout switch for cutting off the fuel oil to the boiler was featured by the Kieley & Mueller Co. in their booth. In addition they showed one of the new type regulating valves for reducing extremely high to medium steam pressures.

In a large exhibit of heating and ventilating equipment, Warren Webster & Co. featured its new high pressure trap made in ½ and ¾ in. sizes for pressures up to 100 lb.

Wm. Powell Co. showed a new line of steel valves, series 150, 300, 400, 600 and 900 lb., made from ⅜ to 24 in. All of the larger valves are adaptable to remote control, with roller bearings and with the motor bracket designed so that it may be placed in eight different positions.

Electric cast steel valves to conform to the new 150, 350, 400, 600 and 900 lb. standards were exhibited by the Reading Steel Casting Co. They can be made in either monel or stainless steel trim. Larger sizes are designed for electric control with ball bearings and pressure lubrication.

New lines of forged steel unit bonnet globe and check valves and flanged bonnet globe, gate and check valves were exhibited by the Crane Co.

Henry Vogt Machine Co. exhibited a new line of high pressure, high temperature flange, gate and globe valves for pressures up to 900 deg. and 900 lb., sizes 2 in. to 4 in.

Built in sizes from 1½ to 2½ in. for pressures up to 400 lb., a new trap was exhibited by the Wright-Austin Co. In addition it exhibited its Clear-view gage glass protector, a semi-circular piece of wired glass surrounding the gage glass on three sides.

Differential vacuum heating systems, designed to maintain a fixed pressure differential between the supply and return side of the system, were featured in the booth of the C. A. Dunham Co., and a unit of the Young centrifugal vacuum and boiler feed pump was maintained in operation to show the construction and the constant power demand of the pump.

Among other exhibitors with Himelblau, Agazim & Co. was featured the Kelly Valve Co.'s self-cleaning gate valve which expands when closed and opens evenly and quickly without wire drawing. Both faces of the valve are cleaned and polished each time it is opened or closed.

Walworth Co. featured a 400-lb., 16-in. gate valve with a Sargol joint and in addition exhibited an 8-in., 900-lb. valve with motor driven control and a 400-lb. ball joint check valve which is a recent development and can be used in any position.

A new line of offset body 400, 600 and 900-lb. forged steel valves with integral flanges and built in 1, 1½ and 2-in. sizes were exhibited by the Edward Valve & Mfg. Co. These valves are made with swivel plug seats and outside screw and yoke.

The Sarco Co. exhibited one of its new type traps built in ½-in. sizes for heating service and in addition showed a large number of other traps, temperature regulators and strainers.

Pressure regulating valves to regulate a predetermined pressure on hydraulic presses were featured by the Hydraulic Press Mfg. Co., together with a semi-automatic pressure control valve for automatically transferring the low and high pressure service on hydraulic presses.

Manning, Maxwell & Moore featured a sectionalized model of an electrically operated pilot controlled safety valve designed to reduce the blow down from safety valves. The feature of this valve is the fact that at 600 lb. it will close with a pressure drop or blow down of 2 lb. or less. The capacity at 600 lb. is 200,000 lb. of steam per hour.

The Everlasting Valve Co. and the Scully Steel & Iron Co. featured the new Everlasting companion angle valve for blow down service, as well as the Wiley-Wilson process of boiler draw-off, wherein a predetermined amount of blow down is drawn off and to a blowoff tank and later discharged under a lower pressure.

A new pilot regulating valve with a specially designed non-cutting seat was featured by the Boylston Steam Specialty Co. and in addition it had a Cat-a-ract low pressure steam trap designed to have the same capacity as the pipe in which it is installed.

The G. M. Davis Regulator Co. exhibited a new type of wing disc valve designed particularly for use in extraction lines on steam turbines, to give a very low pressure drop across the valve.

Lunkenheimer Co. exhibited a new line of outside screw and yoke gate and globe valves and checks for 400 lb., made in sizes from ¼ to 2 in.

Atwood & Morrill featured one of the floating check valves which have been in service at Crawford Ave. for

modulating valves for use on pressure heating systems. This is their new figure 700, designed to control the supply of steam to radiators.

Type C, a new Yarway blowoff valve for pressures up to 900 lb. was featured by the Yarnall-Waring Co. This valve has a double planetary gear and longer body to give protection to the boiler ring while opening and closing and is equipped with two ball bearings.

The National Valve & Mfg. Co. exhibited a number

FIG. 4. CONSTRUCTION AND OPERATION DETAILS WERE BROUGHT OUT BY COMPLETE DISPLAYS AND CUTAWAY MODELS

bleeder service on steam turbines. This company also had a model of its boiler damper regulator, showing the design and method of operation.

A standard Cash D-G single stage large diaphragm reducing valve designed for extreme reductions of pressure from 225 to 5 lb. was featured by the A. W. Cash Co. This valve is built in sizes from 1 to 10 in.

In addition to the regular line of globe, angle, bronze and iron valves, Jenkins Bros. featured one of their new

of pipe joints and featured its 4-6-9 joint, a square lap joint faced on both sides and guaranteed full pipe thickness.

E. B. Badger & Sons Co. exhibited some large self-equalizing type expansion joints and featured its new welded line and monel metal sleeves which are used inside of the joints for high temperatures.

Water proof conduit filler for underground steam pipes was featured by The Ric-wiL Co. with one of the

new service outlets constructed of tile for the purpose of eliminating concrete or brick construction in underground piping construction.

In the exhibit of the Ross Heater & Mfg. Co. a large slip type expansion joint with the new corrosion resisting plating on the slip joint was featured.

The Midwest Piping & Supply Co. showed a large 900-lb. Midwest joint now in use for high pressure lines.

Geo. B. Limbert & Co. showed various types of joints and valves and featured a new reducing Vanstone joint, the exhibit showing the construction with a 4-in. flange on a 3-in. pipe.

The M. W. Kellogg Co. featured its new Kell-Raph tongue and groove joint designed with a copper plated ground steel gasket. The gasket fits into grooves in the forged and hammered flanges.

Various methods of welding and splicing and various types of joints were shown by the Pittsburgh Piping & Equipment Co. Among those exhibited were male and female Vanstone joints with a lip cast on one flange to prevent the gaskets from blowing out. One of the most interesting of the exhibits were pipe sections showing the Vanstoning of wrought-iron pipe in various sizes.

### Important Advances in Instruments and Control Equipment

The Republic Flow Meters Co. featured a new boiler meter and turbine meter panel board which gives continuous records of all the essential data regarding the various equipment on one large strip chart.

Master control operation was exhibited in the booth of the Hagan Corp. in connection with the combustion controller on a small model boiler installation to show the operation and method of regulation. The boilers can be controlled from a central panel or individually as the operator may see fit.

A new type multiple pointer draft gage with a straight line reading scale, liquid level indicator, and scales marked with a color code and illuminated with standard electric lights, was featured by Lewis M. Ellison.

Pointer gages, the new type single piece moving element and the new draft gage diaphragm designed to measure any range of pressure from 1/10 to 150 in. of water were exhibited by the Hays Corp.

The Fisher Governor Co., Inc., exhibited, among other things, its new remote liquid level controls No. 335-338 and featured its Type 215, an ultra-sensitive boiler feed governor equipped with a compound silphon bellows to maintain constant pressure in the boiler by regulating the flow of gas or oil to the furnace.

American Schaeffer & Budenberg Corp. exhibited its new design of recording thermometers and cases and its new 5-in. dial gas thermometer built for range of from 40 to 800 deg.

The Bristol Co. demonstrated long distance electric pressure gages with exceptionally long scale and open faced cases. This exhibit covered a complete line of recording instruments.

Control of the rate of flow by means of the new rate of flow regulator was demonstrated by the Foxboro Co. In addition it showed its new outboard mounting and rigid supports in which the pens of a multi-pen recording instrument are held on a positive center by means of a small rigid bracket.

A new flow meter operating on the induction bridge principle was featured by the Brown Instrument Co. and its new steam-flow, air-flow $CO_2$ chart was demonstrated. This gives the steam-flow, the air-flow, the $CO_2$ and gas temperature all on a single strip chart. The flow meter is built with indicating, recording and integrating charts, with a double range feature whereby during periods of low flows a bypass in the meter body may be operated to give a full scale deflection.

Expansion joints for connection between steam turbines and condensers and coal spout springers for uniform distribution of coal to stoker hoppers were exhibited by the Henry Pratt Co., and as a feature the female section of a large joint to be used in the new Weleetka Station of the Midwest Utilities Co. was exhibited with photographs showing the installations at Cahokia and other large stations.

One of the features of the Crosby Steam Gage & Valve Co. was a new fluid pressure scale tester for testing gages to pressures up to 3000 lb. per sq. in., a compact instrument ready for service when the case cover is removed. This company also showed its new nozzle type safety valves for pressures up to 1600 lb. per sq. in.

The Barton portable pump with automatic primer was demonstrated in the booth of the American Steam Pump Co. This pump is made to be attached to the front end of a crank shaft in an automobile and the primer is operated from the intake manifold of the engine.

In the booth of the Stannard Power Equipment Co. another new development of the American Steam Pump Co. was exhibited. This is known as the day and night condensation pump, made up of a tilt trap receiver fitted with a steam pump and a motor driven centrifugal pump on the same base plate.

Non clogging sewerage pumps made by Yeomans Bros. were featured at the booth of this company. They are made in a range of sizes from 3 to 12 in. and capacities as high as 2500 g.p.m. The impeller is made with exceptionally large passages and the 12-in. pump will pass a 7-in. solid.

The Skidmore Co. exhibited and demonstrated one of its new units known as the hydro-turbine vacuum and boiler feed pump, for return line heating systems or other purposes where gases and liquids are to be handled together.

Chicago Pump Co. had a working model of its sewerage ejector and a number of pumps taken from its new line of ball bearing centrifugals, being built from 1½ to 6-in. sizes for pressures up to 200 lb. per sq. in. and capacities of 2000 g.p.m.

Volute pumps involving the principle of the Roturbo pressure chamber impellers were featured by the Manistee Iron Works as a new line of general service pumps.

Turbo driven boiler feed units were exhibited by the Moore Steam Turbine Co., particular attention being directed to the new type centrifugal, being built in pressures up as high as 400 lb. per sq. in. This series of pumps in 2, 2½, 3 and 4 in. and from 2 to 5 stages are of the single section type with hydraulic thrust bearings.

Among other exhibits in the Barrett-Christie Co.'s booth, was a demonstration unit of Smith-Monroe Co.'s Gast air separators, consisting of a separator with sev-

eral thicknesses of copper wire mesh, designed to remove the moisture from compressed air.

### Water Treating and Boiler Auxiliaries

Designed to eliminate the use of collecting manifold in strainer heads, the new Cochrane conical filter was exhibited and demonstrated by the Cochrane Corp. A single control valve gives complete control of back wash and filtering and other processes, while the rate of flow control is provided to prevent washing out of the sand.

Improved methods of water treatment by means of sodium-aluminate was featured by the Chicago Chemical Co. by means of a small glass boiler model heated by an electric element. New developments of sodium-aluminate giving a high concentration and a very stable solution was explained and testing kits for the purpose of keeping constant control of water treatment methods were exhibited.

Among the exhibitors in the booth of D. H. Skeen & Co., the Stets Co. featured one of the boiler feed controllers which are being supplied to the new Waukegan Station to operate under a pressure of 650 lb. They are of the open float type, so constructed that the float and counterweight may be removed and inspected without breaking the piping.

Pressure regulators for pressures up to and including 900 lb. and 750 deg. were exhibited by the Mercon Regulator Co. A new back pressure type to be installed on the boiler side of the feed water regulator for the purpose of maintaining a constant pressure differential across the regulator was featured.

Improvements on the Type F valve were explained by The "S-C" Regulator Mfg. Co., division of the Swartwout Co., showing the methods by which changes in the water level assist in the opening and closing of the valve to give much closer regulation of boiler feed water.

Chromite, a new metal being used for soot blower elements by the Bayer Co., was exhibited and its resistance to oxidation, corrosion and abrasion was covered in a pamphlet which the company distributed.

In a very effective demonstration, the International Filter Co. showed the efficiency of the new International steam purifier by blowing atomized ink through the filter at a velocity of about 1500 ft. per min.

Schutte & Koerting Co. showed the new Radiafin construction whereby the radiating surface of various sized pipe is increased to a ratio of about 10.56:1. In addition new globe and angle valves, built without baffles for the elimination of moisture from the steam, were featured.

With the exception of a few scattered exhibits, only products directly related to power plant practice were shown and these, because they were well scattered, added to rather than detracted from the interest of the show by tending to break up the monotony which might otherwise have been occasioned by a several days' inspection of strictly power plant equipment.

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In its 1927 construction program, Consumers Power Co. of Michigan is planning to add a 30,000-kw. generating unit with auxiliaries at the Saginaw River plant; to complete a 20,000-kw. pulverized fuel installation at Kalamazoo and to finish the company's new 11-story office building at Jackson. The company plans the expenditure of approximately $15,000,000.

# Large Precipitators for Trenton Channel

For the removal of ash and dust from flue gases, the first and only large installation of equipment for the electrostatic precipitation of ash in a powdered fuel boiler plant is being installed at the Trenton Channel Power Plant of the Detroit-Edison Co. The installation, having what will probably be the highest power rating of any single electrostatic precipitator plant ever built, being made under the supervision of the Research Corp. of New York City, involves the use of the Cottrell process. The smoke given off from the Trenton Channel powdered fuel boiler plant carries with it a large amount of fine ash, which, if it were not removed in some way would result in the distribution from the stack of many tons of ash over the surrounding countryside. By means of the new precipitator, it is claimed that this will be practically eliminated. Nine precipitator units will comprise the final installation, each being served by two 25-kv.a. electrical sets. Two precipitator units are already in use and the remainder will be installed early this year. The high voltage power will be supplied from 18 specially designed 25-kv.a. transformers, of which 14 units are now under construction at the Pittsfield plant of the General Electric Co. These units will step up to 220-v., single-phase, 60-cycle power supply to 75,000 v. The high voltage will then be timed through mechanical rectifiers built by the Research Corp. and each driven by a single horsepower ball-bearing synchronous motor of special design and furnished by the General Electric Co. The high voltage direct current from the rectifier will be supplied directly to the feeders.

The precipitators are of the graded resistance type, consisting of parallel grounded concrete plates between which will be suspended anodes connected to the negative side of the direct current circuit. The positive side of the direct current circuit will be connected to the concrete plates and a corona discharge will flow from the suspended anodes to the concrete cathodes. The smoke exhausted from the boiler plant will pass between the concrete plates and the suspended ash will be ionized by the corona discharge and deposited on the concrete plate, whence it will be removed periodically by mechanical means, dropping into hoppers below. Periodic removal from the hoppers will complete the process.

By means of a number of taps in the low voltage winding of each transformer, it will be possible to select the best operating voltage at which the precipitator will operate. These tests will provide, besides the 75,000 v., voltages of 70,000, 65,000 and 55,000.

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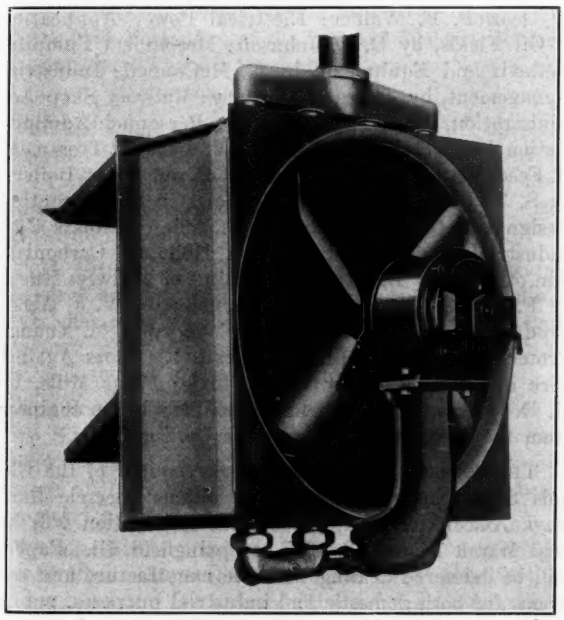
For the first time in 17 yr. the American Society of Mechanical Engineers will hold a meeting of national scope at a well known resort. This will be the 1927 spring meeting to be held at White Sulphur Springs, W. Va., May 23 to 26, 1927.

While nothing will be sacrificed as far as the technical side of this meeting is concerned, full advantage will be taken of the splendid opportunity afforded for sport and recreation. The afternoon and evening entertainment events will be under the direction of a committee, of which J. G. Worker is chairman, and a ladies' committee is also being organized.

# POWER PLANT ENGINEERING DEVELOPMENTS AND NEWS

## Unit Heater for Industrial Buildings

IN VIEW of the increasing interest during the past few years in unit heaters for industrial buildings, several new and interesting types of such apparatus have been developed, one of which is the Herman Nelson



EXTENDED SURFACE-TYPE RADIATOR, THROUGH WHICH MOTOR-DRIVEN FAN FORCES AIR, IS DESIGNED FOR STEAM PRESSURES UP TO 125 LB.

model 20 unit heater made by The Herman Nelson Corp., Moline, Ill., and shown in the accompanying illustration.

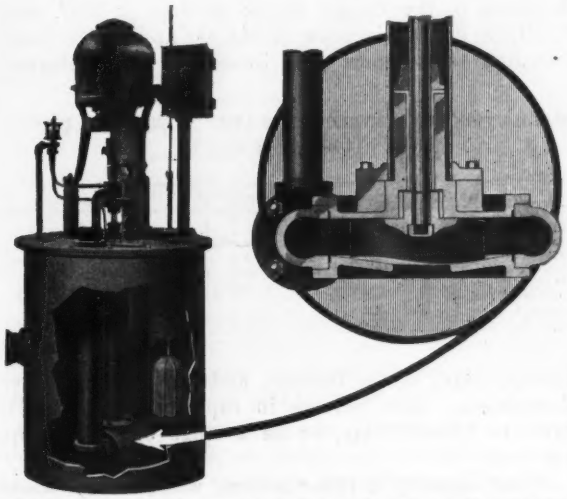
The radiator in this heater is of the extended surface type with the core or steam way cast in one piece of a special alloy. Upon this core aluminum fins are wedged and held in intimate metal-to-metal contact by spring action. This design is intended to eliminate leakage and to prevent the loosening of the fins by vibration, thus preserving their conducting efficiency. The core is designed also to eliminate air pockets or excessive resistance.

The heater is designed to operate on any steam pressure from atmospheric to 125 lb. The model 20 unit shown in the illustration, complete with motor and deflector weighs approximately 170 lb. and occupies 4 cu. ft. of space. In some cases it has been hung directly from the pipe line, thus materially reducing installation cost.

At 1150 r.p.m. each unit will deliver in excess of 2000 c.f.m. while at 850 r.p.m. it will deliver in excess of 1200 c.f.m. At 1150 r.p.m. with inlet air at 50 deg. and steam pressure at 5 lb., it is designed to deliver the equivalent of 560 ft. of radiation. With inlet air at 50 deg. and steam pressure of 100 lb., it is designed to deliver the equivalent of 960 sq. ft. of radiation. Each unit may be automatically or manually controlled without reference to any other unit. The standard unit may be installed to recirculate and heat room air, to take outside air and heat it, or to heat both outside and inside air.

## Screenless Sewage Ejector Meets Exacting Tests

SEVERAL YEARS AGO there was developed a non-clogging centrifugal sewage pump for municipal service. The design of this pump was such that it would readily pass all types of solids, thus eliminating the



SCREENLESS EJECTOR AS DEVELOPED FOR BUILDING SERVICE, SHOWING PUMP DETAILS

use of screens and the consequent necessity for frequent cleaning, an expensive and unpleasant task.

This feature met with much favor and many of these pumping units were installed. This prompted the manufacturer to go a step farther with the non-clogging equipment and it was then adapted to city building service, as shown in the illustration. Here, too, it met with the approval of many architects and engineers

and many of the screenless ejectors are now in operation in such service.

The chief feature of the ejector is the non-clogging impeller designed to pass all kinds of solids through the pump. It is designed with unusually wide blades, large water passages and rounded forward blade ends. There are just two water-ways in the impeller and no hub or vanes obstructing the entrance.

In a recent test of a Form A ejector of this type at the new Parker House, Boston, six pieces of Kotex and two pieces of burlap, measuring 12 in. by 18 in. were thrown into the pump receiver. The receiver was pumped dry, refilled, and six more pieces of Kotex and burlap thrown into it. The basin was pumped dry and again opened. It was found that everything had been passed through the pump.

In a second test, more than double the quantity of material was used. So much burlap was thrown in that it was enough to make a suit of overalls, and it was in good sized pieces. The pump was started and the receiver emptied. On opening the pump, it was found to be entirely free and clear of any obstructions whatever.

Two interesting bulletins describing this equipment have just been issued by its manufacturer, Yeomans Bros. Co., Chicago, Ill. Bulletin No. S-6000 describes the municipal pump and No. BS-340 describes the building service type. These can be obtained upon request to the company.

# Geological Survey Reports on Prime Movers

TOTAL CAPACITY of water wheels in water power plants in the United States on Jan. 1, 1927, was 11,721,000 hp., an increase of 544,000 hp. for the year, according to a report just issued by the Geological Survey, Dept. of the Interior, and the Federal Power Commission. The increase in capacity since Jan. 1, 1910, is 7,800,000 hp., or an average of 460,000 hp. per year.

DISTRIBUTION OF DEVELOPED WATER POWER IN UNITED STATES

| Division | Percentage of total in United States | | | | | |
|---|---|---|---|---|---|---|
| | 1910 | 1921 | 1924 | 1925 | 1926 | 1927 |
| New England | 24.6 | 16.5 | 15.3 | 14.0 | 13.3 | 13.1 |
| Middle Atlantic | 22.1 | 18.7 | 19.1 | 19.4 | 17.9 | 17.5 |
| East North Central | 9.7 | 9.3 | 9.1 | 8.8 | 8.8 | 8.6 |
| West North Central | 5.1 | 5.6 | 5.1 | 5.1 | 4.7 | 4.6 |
| South Atlantic | 8.8 | 13.6 | 14.3 | 15.8 | 15.2 | 15.7 |
| East South Central | .7 | 3.1 | 3.8 | 4.0 | 6.7 | 7.4 |
| West South Central | .2 | .2 | .2 | .3 | .3 | .3 |
| Mountain | 7.4 | 10.4 | 9.7 | 9.3 | 8.8 | 8.8 |
| Pacific | 21.4 | 22.6 | 23.5 | 23.3 | 24.5 | 24.0 |

Total capacity of prime movers, water wheels, steam engines and turbines and internal combustion engines in public utilities, manufactures and mines and quarries (locomotives, motor vehicles, and water craft not included) is estimated from data published by the Bureau of the Census for 1923 and previous years as 56,500,000 hp., an increase of 26,000,000 hp. since 1910. On Jan. 1, 1910, water wheels constituted 13.7 per cent of the total capacity of prime movers and on Jan. 1, 1927, they constituted 20.7 per cent, showing a comparatively small but nevertheless increasing proportion of water power development.

In the accompanying table is shown the distribution of the developed water power in the United States by sections. California became the leading state in developed water power during 1925, leading New York state, her closest competitor, by 160,000 hp. On this date New York had 15 per cent of the total for the United States and California 16.4 per cent. The state of Washington, which has held third place since 1921, was displaced by Alabama with 5.6 per cent.

# News Notes

AS DEVELOPED UP TO DATE, the program of the A.S.M.E. Kansas City meeting gives promise of much of value and interest to the engineers who will attend it from various parts of the country.

Among the papers scheduled are: The Place of Railroad Apprenticeship in National Apprenticeship Plan, by F. W. Thomas; Training for Foremanship, by L. A. Hartley; Education Training for Industry, by Dean P. F. Walker; Electrical Power Application in Oil Fields, by D. L. Johnson; Mechanical Pumping Methods and Equipment, by G. McConnell; Industrial Management, by James McQueeney; Railway Shop Administration, by Wm. R. Harris; Personnel Administration in Steel Industry, by F. V. Larkin; Treatment of Feed Water for Industrial and Power Plant Boilers, by S. T. Powell; Present Tendencies in Steam Station Design and Generation, by V. E. Alden; Kansas City Industrial Development, by Lou Holland; Carbonization of Coal, by Dr. Runge; Burning of Midwest Fuels, by F. S. Collings; Industrial Furnaces, by V. J. Azbe; Production and Distribution of Fuel, by C. M. Young; Protection of Flour Mills and Grain Elevators Against Fire and Explosion, by F. D. Hoxie; Flour Mills, by M. D. Bell; and Agricultural Machinery by an engineer from the International Harvester Co.

THE SEVENTH ANNUAL JOINT CONVENTION of the Illinois State Electric Association, Illinois Electric Railways Association and Illinois Gas Association will be held March 17 and 18, 1927 at Springfield, Ill. Papers will be delivered dealing with the manufacture and use of gas for both domestic and industrial purposes, public relations will be discussed by leading men of the industry and several papers will be delivered on problems connected with electric railway operation. Complete information concerning this convention can be obtained from R. V. Prather, secretary and treasurer, 205 Illinois Mine Workers Bldg., Springfield, Ill.

THE CHICAGO ASSOCIATION OF CONSULTING ENGINEERS on January 17, 1927, at its regular meeting in the City Club, held its annual election. Irving E. Brooke was elected president; Ernest V. Lippe, vice-president, and Rollo E. Gilmore, secretary and treasurer.

This organization meets regularly on the third Monday of each month at the City Club, 315 Plymouth court, Chicago, Ill., having a dinner followed by regular business meeting.

IN CONNECTION with the recent removal of the International Combustion Engineering Corp. and its subsidiaries to its new building on Madison avenue in New York City, it is stated that part of the space in the International Combustion Building will be used by the

company in completing the design of engineering detail of its first large orders for equipment for the distillation of coal at low temperatures developed by Dr. Runge and Samuel McEwen. In addition, a half floor in this building has been turned over to a department under the direction of Dr. William L. De Baufre for perfecting an entirely new phase of power plant development which has been continuously sought for many years and which combines the use of pulverized coal and low temperature distillation.

THE NEW YORK office of B. F. Sturtevant & Co. will be moved into the Graybar Building about the time this building is finished, April first.

THE HILL CLUTCH MACHINE & FOUNDRY CO., Cleveland, Ohio, recently appointed Charles C. Phelps, 473 Getty Ave., Paterson, N. J., as sales engineer for the metropolitan New York and northern New Jersey districts.

THE AIR PREHEATER CORP., New York City, announces that G. O. French, for the past 10 yr. associated with the New York office of the Walsh & Weidner Boiler Co., has joined The Air Preheater Corp. as New York and eastern sales manager.

PIONEER RUBBER MILLS, San Francisco, Calif., opened a new factory branch at Chicago, Ill., on Feb. 1 with E. P. Coxhead in charge. This office will handle the middle western states which were formerly under the jurisdiction of the New York office.

C. H. CHRISTMAN, who has spent the past seven years as research chemist with the Clinton Corn Syrup Refining Co., has resigned to undertake research work in the laboratory of the Chicago Chemical Co., manufacturer of K.W.S. sodium aluminate.

THE EDISON ELEC. ILLUMINATING CO., Boston, Mass., at its Edgar station, plans the installation of a new 10,000-kw. turbo-generator to operate under a steam pressure of 1200 lb. The new unit will be furnished by General Electric Co.

WILSON & CO., packer, Los Angeles, is installing three Collins water-tube boilers designed for 170-lb. pressure, a Graver hot process water softener and heater and Union boiler feed pumps in its power plant, installation being supervised by the Southwestern Engineering Co., of Los Angeles.

ELLIOTT CO., Jeanette, Pa., announces the election of additional executive officers made necessary by the expansion of the company's business. James E. Watson continues as executive vice-president and G. F. Elliott has been elected vice-president and assistant to the president. He has also been appointed general manager in charge of the Ridgway Dynamo & Engine Works of the company. R. N. Ehrhart has been elected vice-president in charge of Elliott Co. and its subsidiaries.

AT THE ANNUAL MEETING of the Engineering Foundation on February 17, 1927, in the Engineering Societies Building, 29 West 39th street, New York City, Lewis Buckley Stillwell was re-elected chairman. Mr. Stillwell is a New York engineer residing in Lakewood, N. J., a graduate of Lehigh and a life trustee of Princeton, with a degree of doctor of science from Wesleyan. He is past president of the A.I.E.E. and the A.I.C.E., a member of the A.S.C.E., the Institute of Electrical Engineers of Great Britain, American Engineering Council, and other American and international societies.

Arthur D. Little, founder and president of the Arthur D. Little Laboratories, Cambridge, Mass., was elected vice-chairman. George A. Orrok, member of the A.S.M.E. and A.I.M.&M.E. and A.S.C.E., was re-elected vice-chairman. J. Vipond Davies and Dean Arthur M. Greene, Jr., were again named as members of the executive committee. Alfred D. Flinn was elected director and secretary, Jacob S. Langthorn, treasurer, and Harry A. Lardner, assistant treasurer.

BENJAMIN CARPENTER, president of George B. Carpenter & Co., railroad, mill and contractors' supplies, of Chicago, died February 23 at his home in Chicago after an illness of more than 2 yr.

ACCORDING TO A RECENT ANNOUNCEMENT, this year marks the 50th anniversary of The Kennedy Valve Mfg. Co., which was founded in 1877 by Daniel Kennedy, who is still president and in active charge of the Kennedy organization.

After successively outgrowing the four-story building in New York City, in which it was started, and a larger plant at Coxsackie, N. Y., the company moved in 1907 to Elmira, N. Y., to a much larger plant covering a total of 35 acres, which it now occupies.

THE ALEXANDER MILBURN CO., Baltimore, Md., has recently developed a 3-in-1 spray gun for coating any surface with paint, varnish, enamel, lacquer and the like. This gun incorporates a multiple head adjustment to permit either a flat fan spray in either horizontal or vertical position or a round spray. It is designed for extremely fine atomization. An air pocket formed by the fan-shaped nozzle completely surrounds the atomized spray and lessens the loss of material through evaporation and utilizes the entire spray to cover the surface. Both the air and paint valves are designed to operate simultaneously.

## Catalog Notes

W. H. NICHOLSON & CO., Wilkes-Barre, Pa., has just issued Bulletin No. 127, describing the Nicholson three and four-way valves for air, steam or water on pressures up to 500 lb.

BOSTON GEAR WORKS SALES CO., Norfolk Downs, Mass., in a new 36-page booklet, CI-27, describes and illustrates its line of standardized speed reducers showing photographs and line drawings of the equipment with tables of dimensions and price list.

COMBUSTION ENGINEERING CORP., New York City, has issued Catalog No. 19, an attractively illustrated discussion of Raymond automatic pulverizers. The bulletin discusses modern grinding and pulverizing with air separation and describes various types of Raymond pulverizers with line drawings and photographs of typical installations and goes into considerable detail in the discussion of both the construction of the pulverizers and their operation. A description of the complete air circulation is also included.

BULLETIN NO. 673 on filters published by the Cochrane Corp., Philadelphia, Pa., describes pressure filters, including a new form called the Cochrane strainerless conical filter, in which strainer heads or pipe manifolds

are not employed to withdraw the water from the bottom of the filter or to effect the distribution of the wash water, both functions being performed by the shape of the filter casing. For convenient operation a single control valve is also installed, together with a flow rate controller to prevent operating the filter beyond its capacity or to control the rate of back washing. The bulletin describes also several forms of chemical proportioners and the removal of oil from condensate by means of coagulation and filtration.

AMERICAN SCHAEFFER & BUDENBERG CORP., Brooklyn, N. Y., in its new catalog, No. 500, discusses all types of American Tachometers for indicating and recording speed directly in r.p.m. or f.p.m. The bulletin contains many interesting installation photographs showing these tachometers applied to hydraulic turbines and their governors and steam turbines. The operation of the instrument is described and considerable data are given concerning the American recording tachometer which records speed on a circular or strip chart. Various types of stationary recording instruments are described and illustrated with tables of dimensions and sizes.

CHICAGO CHEMICAL CO., Chicago, Ill., in No. 15 of its publication, "Clean as a Whistle," describes and illustrates its water treatment specialties, including both the chemicals and apparatus necessary. No. 16 of this publication contains a discussion of how to prevent carryover, including an interesting chart showing the relation between suspended solids and total solids, based on operation ratings of 175 per cent and showing the concentration of total solids that can be carried. No. 17 discusses General Aspects of Water Treatment for Railroads.

THE PROPER STORAGE of Your Oils Costs Nothing is the interesting title of a large illustrated folder recently issued by S. F. Bowser & Co., Inc., Fort Wayne, Ind. This folder describes and illustrates apparatus and methods of storing and measuring oil and eliminating waste in the handling of lubricating oils and many other liquids such as benzine, coal tar, fuel oil, gasoline and paints. A phantom view of a typical Bowser storage installation is shown, indicating the safety and convenience of the methods.

THE FOXBORO CO., INC., Foxboro, Mass., in an illustrated folder, describes briefly its recording flue-gas thermometer, its $CO_2$ recorder and its triplex draft gage. These three instruments are described together because the company states it considers them to be essential in reaching and maintaining economical furnace performance.

BELMONT PACKINGS for steam, air, ammonia, hydraulic machinery, oils, gases and acids are described in General Catalog No. 6, just issued by Belmont Packing & Rubber Co., Philadelphia, Pa.

THE CONSTANTATOR CO., Inc., New York, in bulletin No. 10, describes and illustrates the Constantator, a recently developed type of boiler room regulator, which operates electrically and analyzes pressure changes operating only when a positive change takes place.

THE LEATHER BELTING Exchange, Philadelphia, Pa., has recently issued Research Bulletin R-16. This contains a report of experiments on horizontal quarter-turn drives. While there has been a good deal written and printed about belting and belt transmission, there has been very little printed about quarter-turn drives. It was with the idea in mind of presenting some reliable information on this phase of belting that the present bulletin was prepared. The object of the experiment was to study the transmission capacity of horizontal quarter-turn drives when compared with normal horizontal drives, and thus establish a more correct basis of design for such drives. Another object was to fry out certain combinations of pulleys in center distances, in the hope of learning more about practical layout for quarter-turn drives. The experiments show that the quarter-turn drive is a desirable one and that it can be operated successfully when properly installed. The bulletin also provides some intelligent basis for the calculation of capacities.

THE CHICAGO PUMP CO., Chicago, Ill., has recently issued a number of its attractively illustrated bulletins, bound in a substantial binder with a convenient table of contents. These bulletins describe the various types of centrifugal pumps, pneumatic water supply systems, automatic electric bilge pumps and sewage ejectors made by the company.

MELLISH-HAYWARD CO., Chicago, Ill., in Bulletin 10-A, describes the Mel-Rock Air Washer, Type A. In this apparatus, air is passed through a chamber filled with a live and minute spray of water and then comes in contact with a series of wet and dry plates, called eliminators, arranged to eliminate any solid particles and also any free particle of water.

THE BROWN INSTRUMENT CO., Philadelphia, Pa., in a new catalog No. 75, just issued, describes and illustrates a complete line of indicating, recording, signaling and controlling pressure gages. This catalog is a revision of a former edition and, in addition to pressure and vacuum gages, it includes descriptions and illustrations of Brown draft gages. A revised chart list, including strip charts, is presented.

PROTECTION is the title of the latest circular on Autovalve Lightning Arresters released by the Westinghouse Electric and Manufacturing Co.

The publication starts out with an interesting discourse on the nature and magnitude of transient voltages on electrical systems, describing surge voltages as built up by induction, the scope of a surge, its action and other characteristics, which is followed by a discussion of the operation and requirements of the arrester.

THE DAMPNEY CO. of America, Hyde Park, Boston, Mass., in Bulletin 1092 discusses the corrosion of boiler tubes and drums, steel tube economizers, feed-water heaters and steam turbines. The Apexior, trade name of the protective coating manufactured by this company, is designed to possess all the qualities for protecting such apparatus against corrosion. This material is a grey-black liquid, similar in consistency and appearance to paint. Soon after it is applied, a smooth, hard, continuous protective coating is left on the metal surface.

"THE UTILIZATION OF WATER POWER in the Czechoslovak Republic," by Joseph Wolf, chief building councillor, Ministry of Public Works, Prague, is an interesting discussion of the systematic electrification of the Czechoslovak republic and of the various hydro-electric plants now in operation, together with many illustrations and tables of date.